

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
23 October 2003 (23.10.2003)

PCT

(10) International Publication Number
WO 2003/088316 A3

(51) International Patent Classification⁷: C25D 5/00, 5/48, 5/52, 5/50, 5/08, B23H 11/00, 3/00, 5/00, 7/00, 9/00 (74) Agents: YIM, Peter, J. et al.; Morrison & Foerster LLP, 425 Market Street, San Francisco, CA 94105-2482 (US).

(21) International Application Number:
PCT/US2003/011417

(22) International Filing Date: 11 April 2003 (11.04.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/372,263 12 April 2002 (12.04.2002) US
60/382,133 21 May 2002 (21.05.2002) US
60/387,826 8 June 2002 (08.06.2002) US
60/398,316 24 July 2002 (24.07.2002) US

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

(88) Date of publication of the international search report:
31 December 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ELECTROPOLISHING AND ELECTROPLATING METHODS

(57) Abstract: In one aspect of the present invention, an exemplary method is provided for electroplating a conductive film on a wafer. The method includes electroplating a metal film on a semiconductor structure having recessed regions and non-recessed region within a first current density range before the metal layer is planar above recessed regions of a first density, and electroplating within a second current density range after the metal layer is planar above the recessed regions. The second current density range is greater than the first current density range. In one example, the method further includes electroplating in the second current density range until the metal layer is planar above recessed regions of a second density, the second density being greater than the first density, and electroplating within a third current density range thereafter.

WO 2003/088316 A3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/11417

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C25D 5/00, 5/48, 5/52, 5/50, 5/08; B23H 11/00, 3/00, 5/00, 7/00, 9/00

US CL : 205/96, 640, 644, 220, 223, 224, 133

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 205/96, 640, 644, 220, 223, 224, 133

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,162,344 A (REID et al) 19 December 2000 (19.12.2000), col. 2 and claims 3, 4, and 5.	1-20
X	US 6,261,963 B1 (ZHAO et al) 17 July 2001 (17.07.2001), cols. 6 and 7.	21-37, 51-66
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A		67-78
X,P	US 2003/0038038 A1 (BASOL et al) 27 February 2003 (27.02.2003), paragraph 0025.	38-50
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A,P		51-78
X	US 2002/0000271 A1 (RITZDORF et al) 3 January 2002 (03.01.2002), paragraphs 0001 to 0077.	38-66
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A		67-78

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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
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Date of the actual completion of the international search

24 September 2003 (24.09.2003)

Date of mailing of the international search report

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Name and mailing address of the ISA/US

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Alexandria, Virginia 22313-1450

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Wesley A. Nicolas

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X	US 2002/0000271 A1 (RITZDORF et al) 3 January 2002 (03.01.2002), paragraphs 0001 to 0077.	38-66
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"B" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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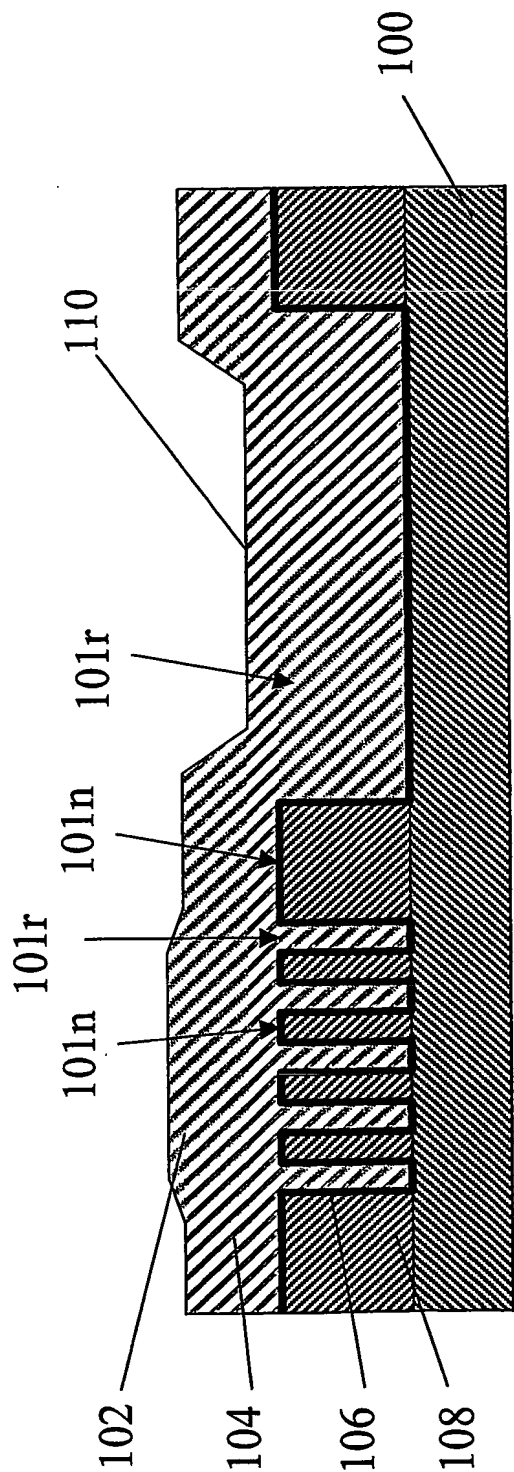


Fig. 1A

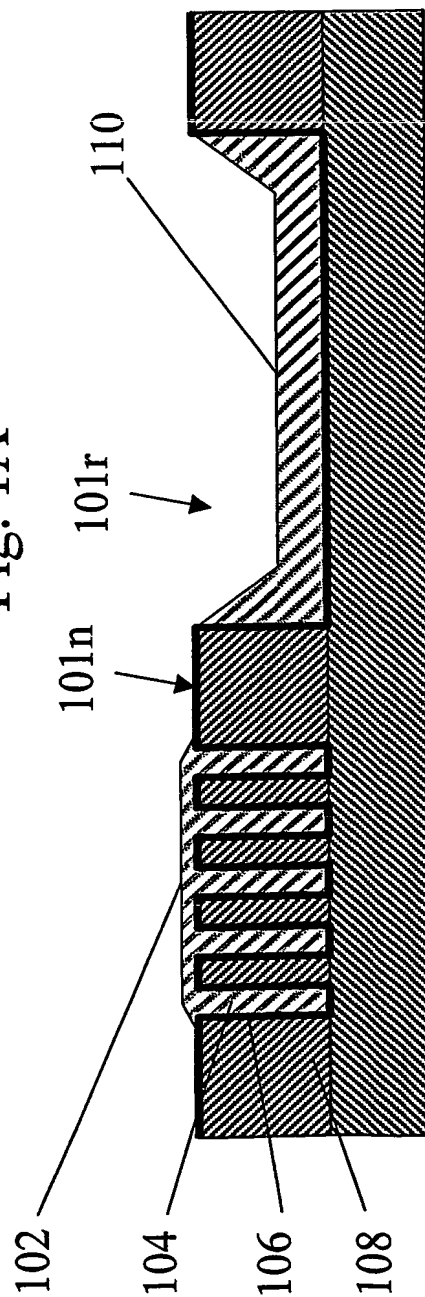


Fig. 1B

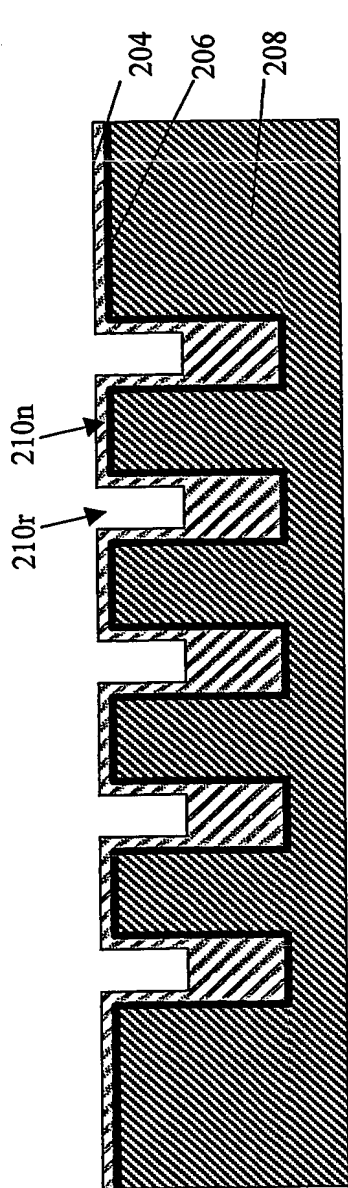


Fig. 2A

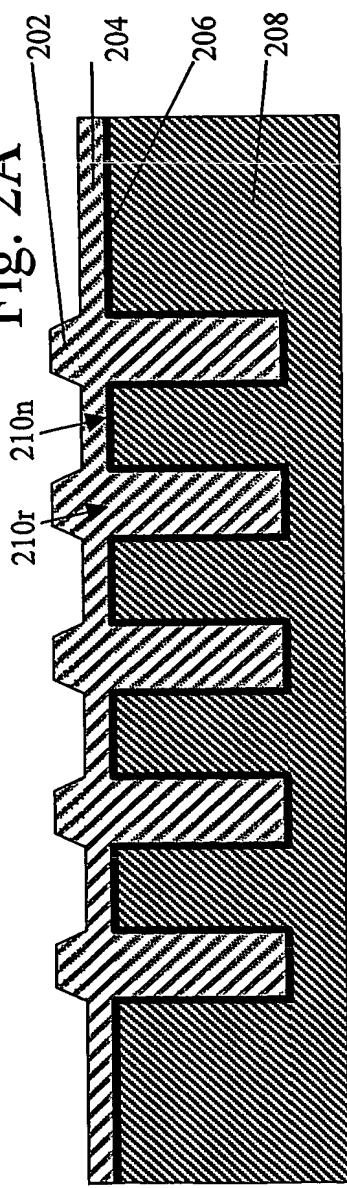


Fig. 2B

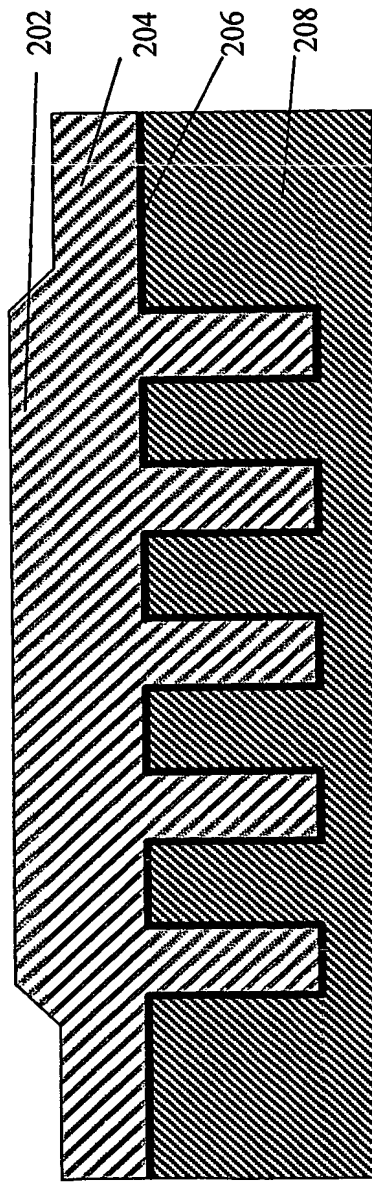


Fig. 2C

Plating Time

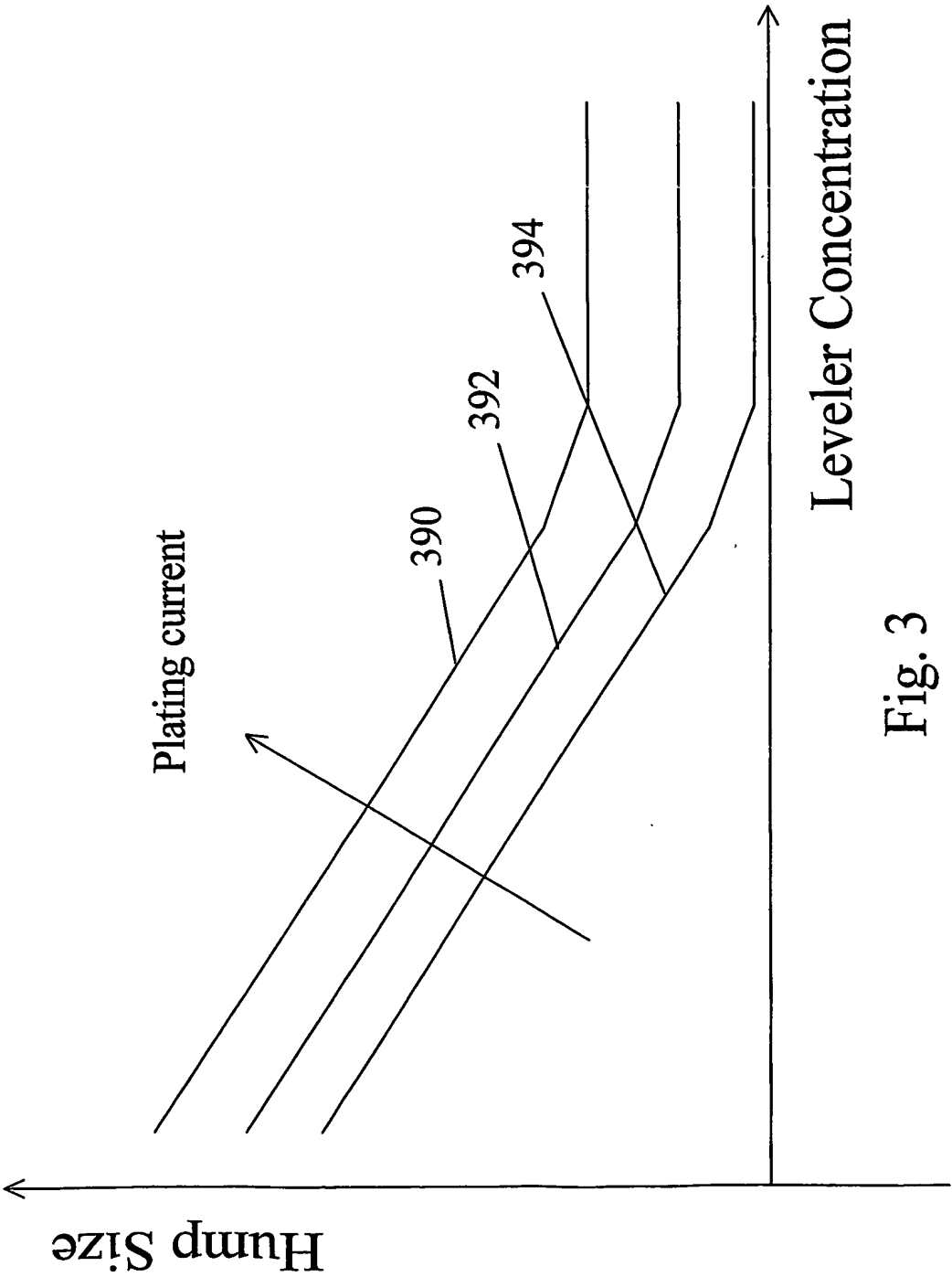


Fig. 3

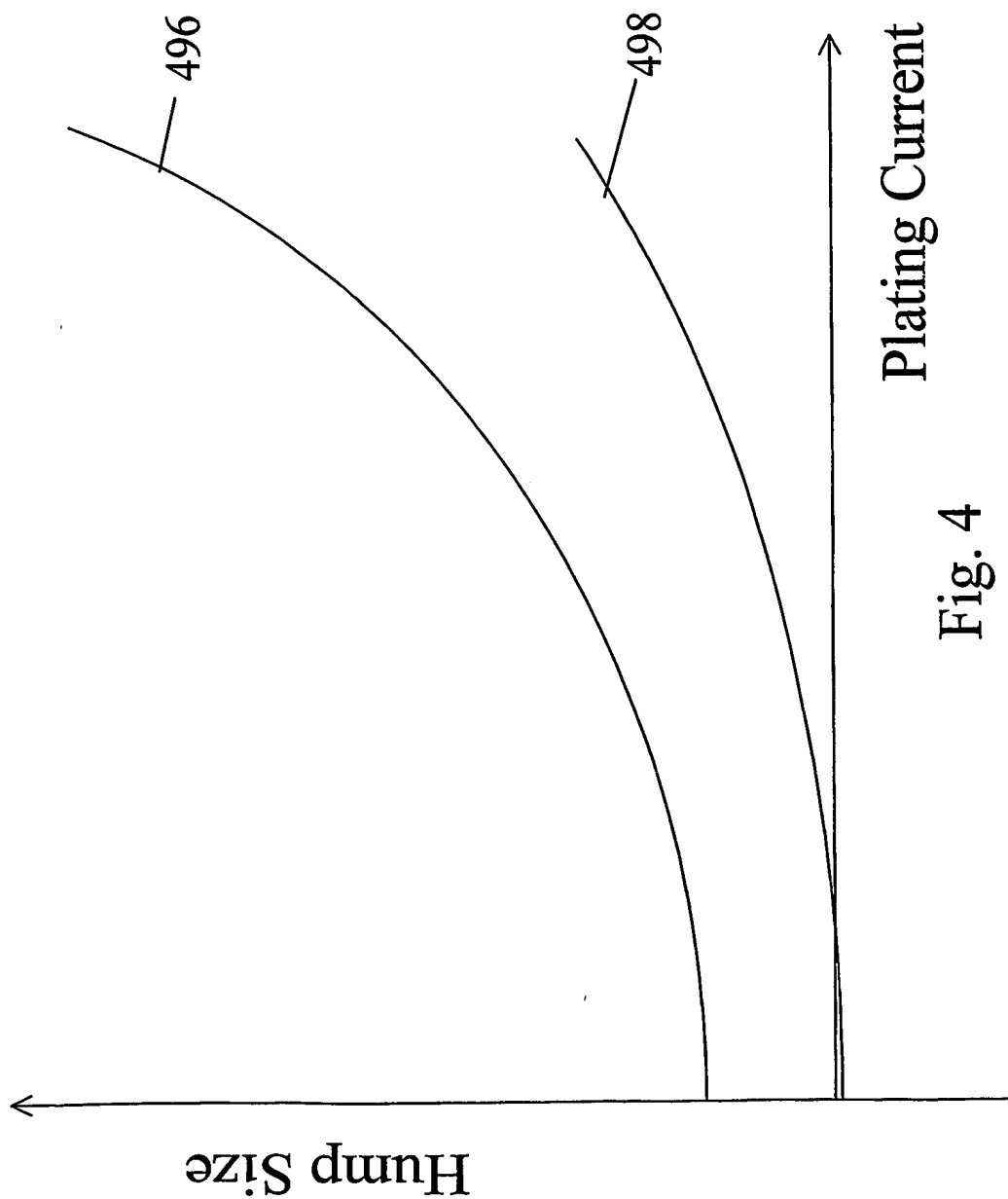
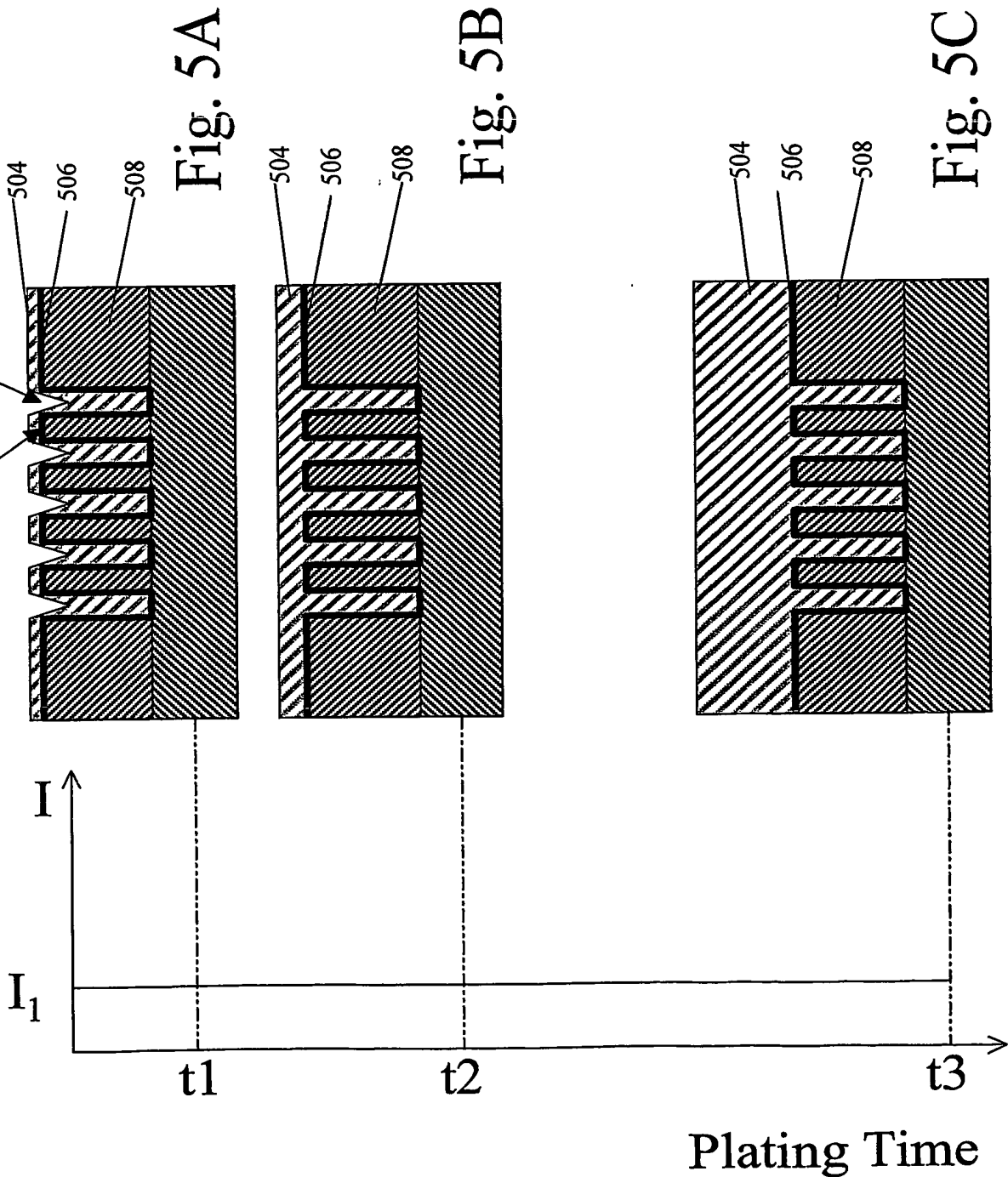
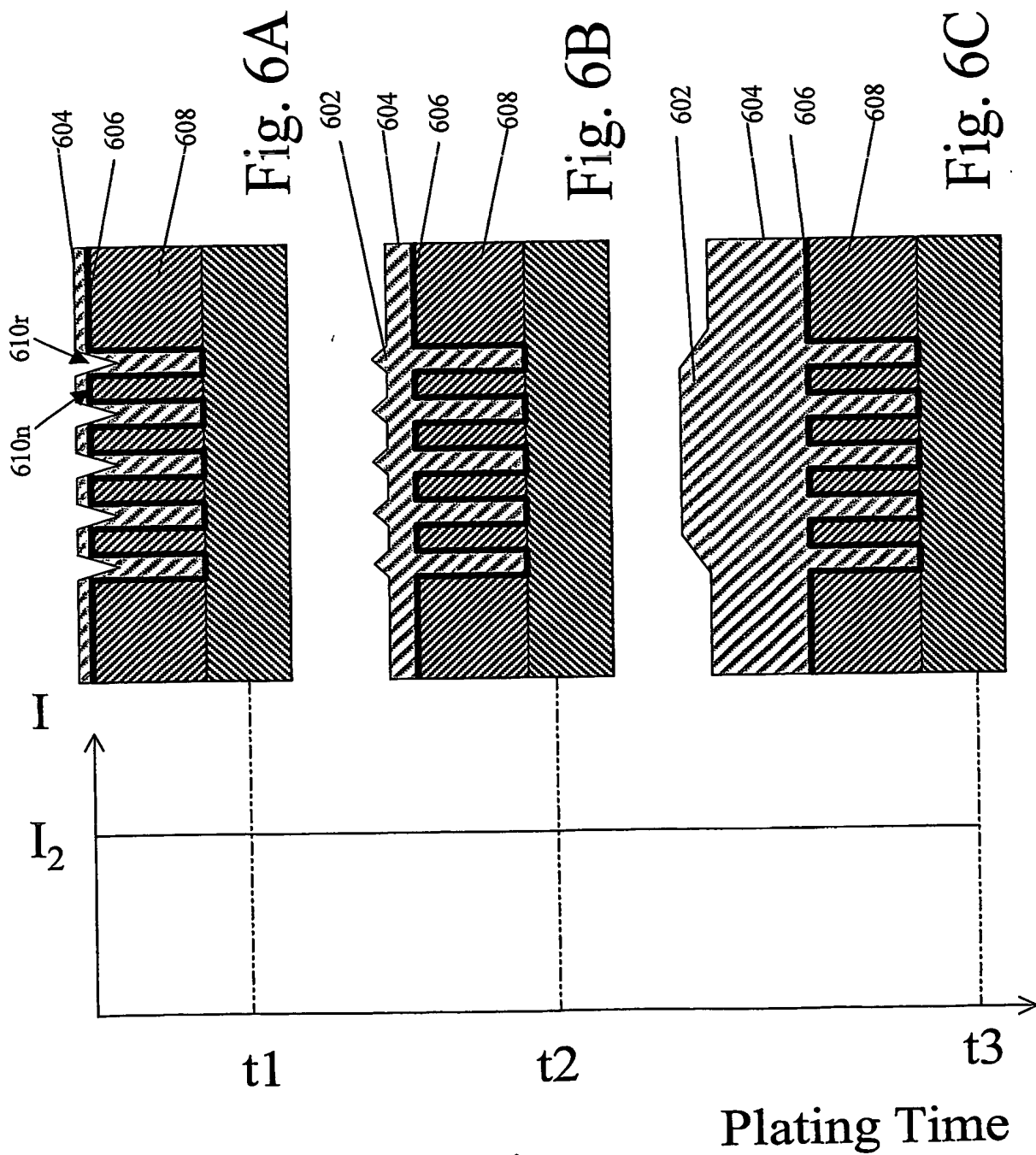
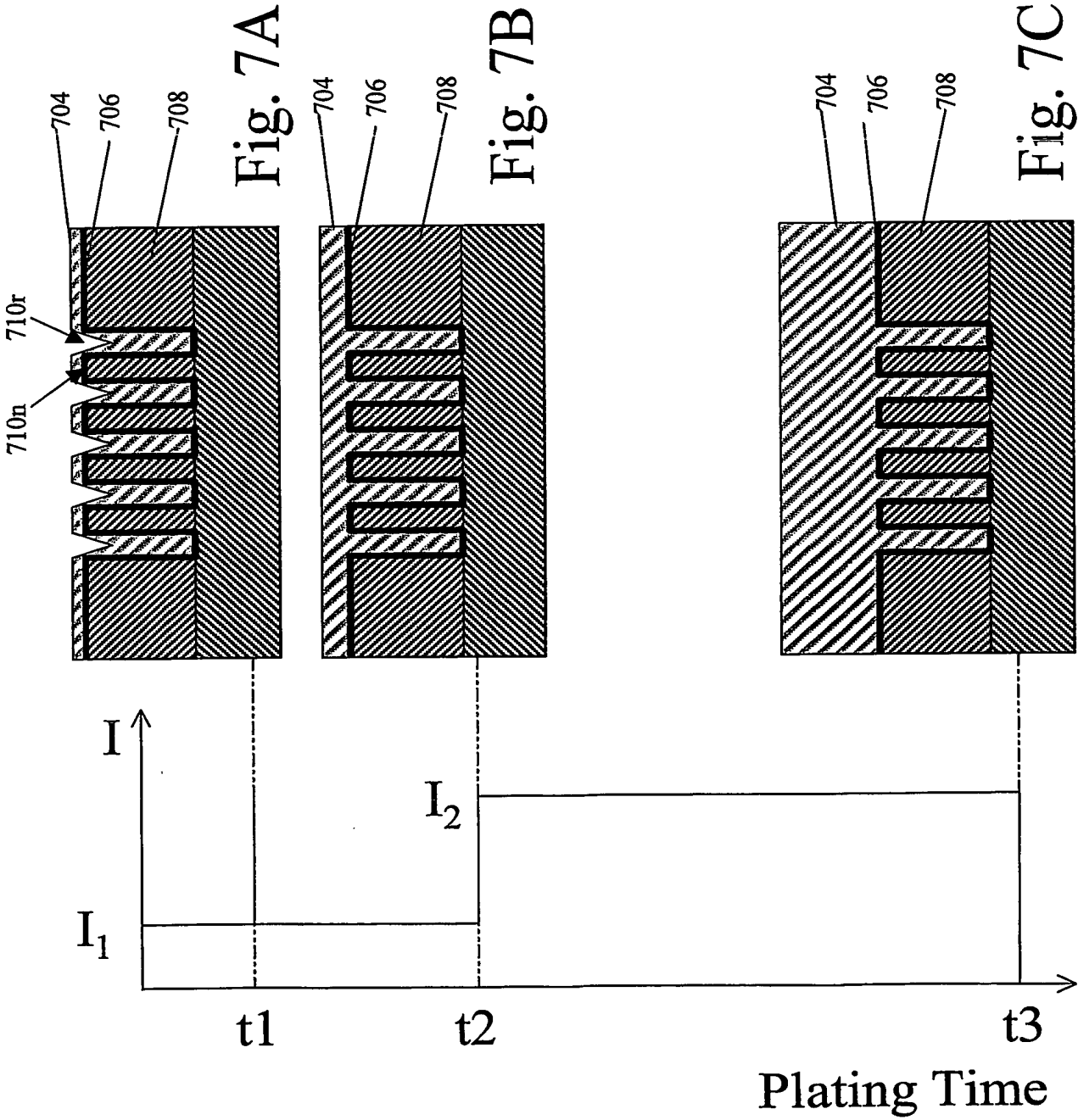
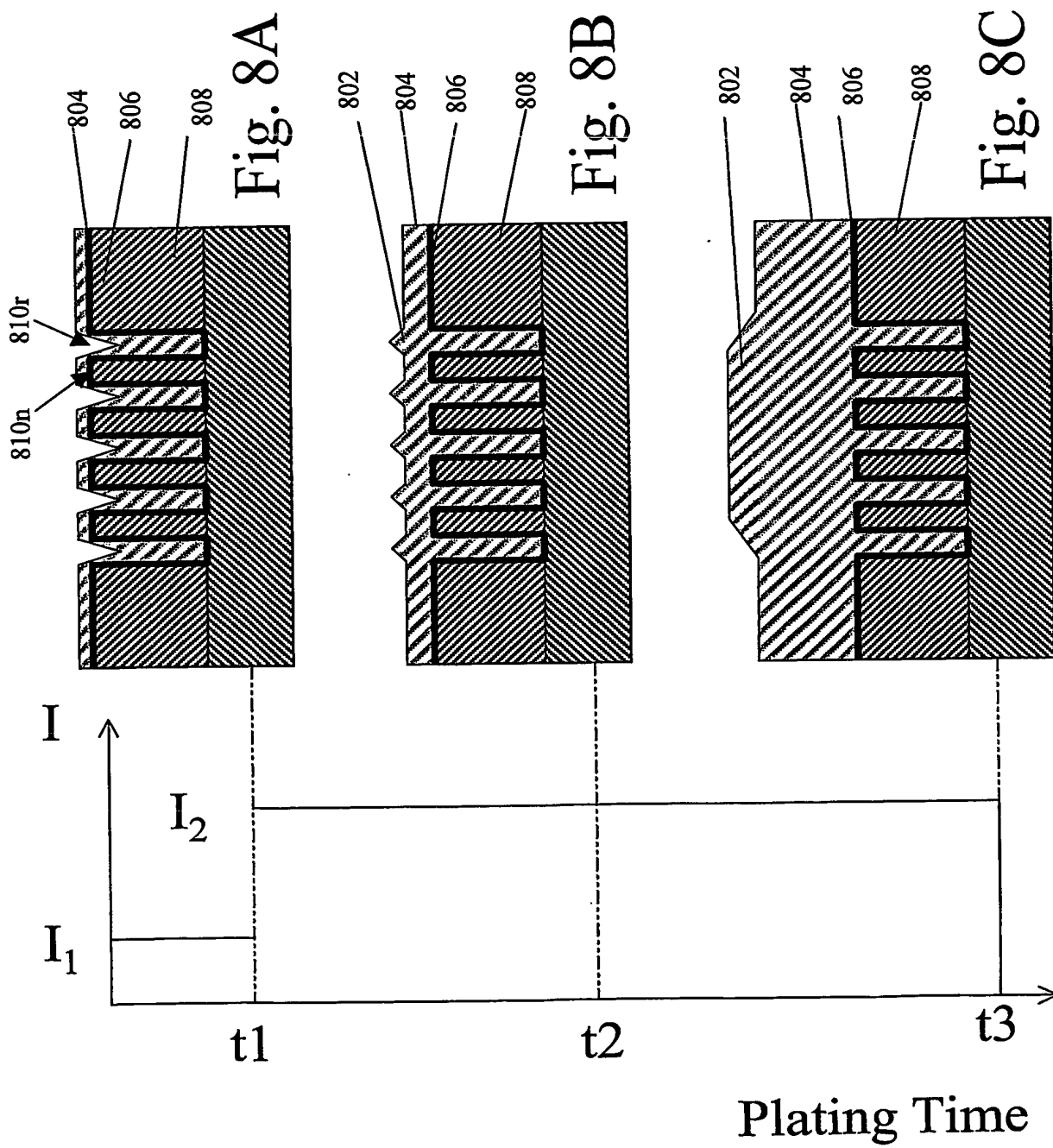


Fig. 4









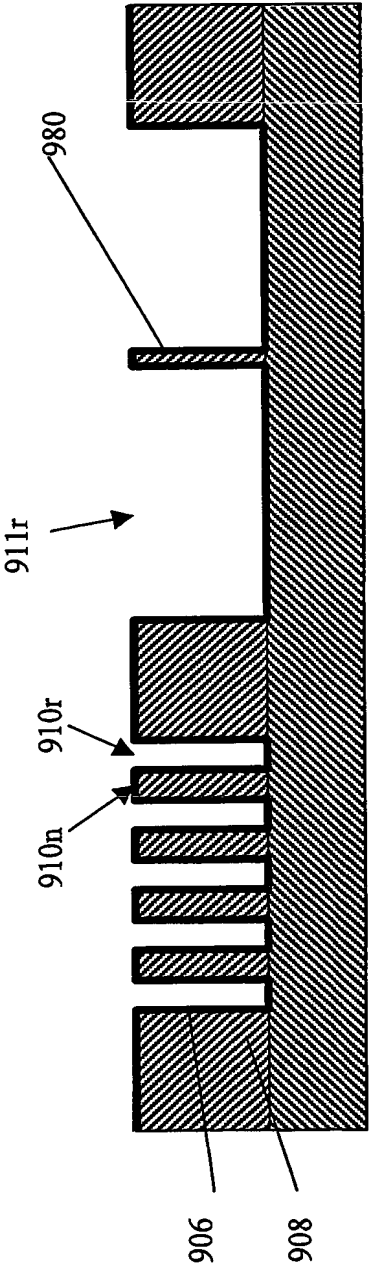


Fig. 9

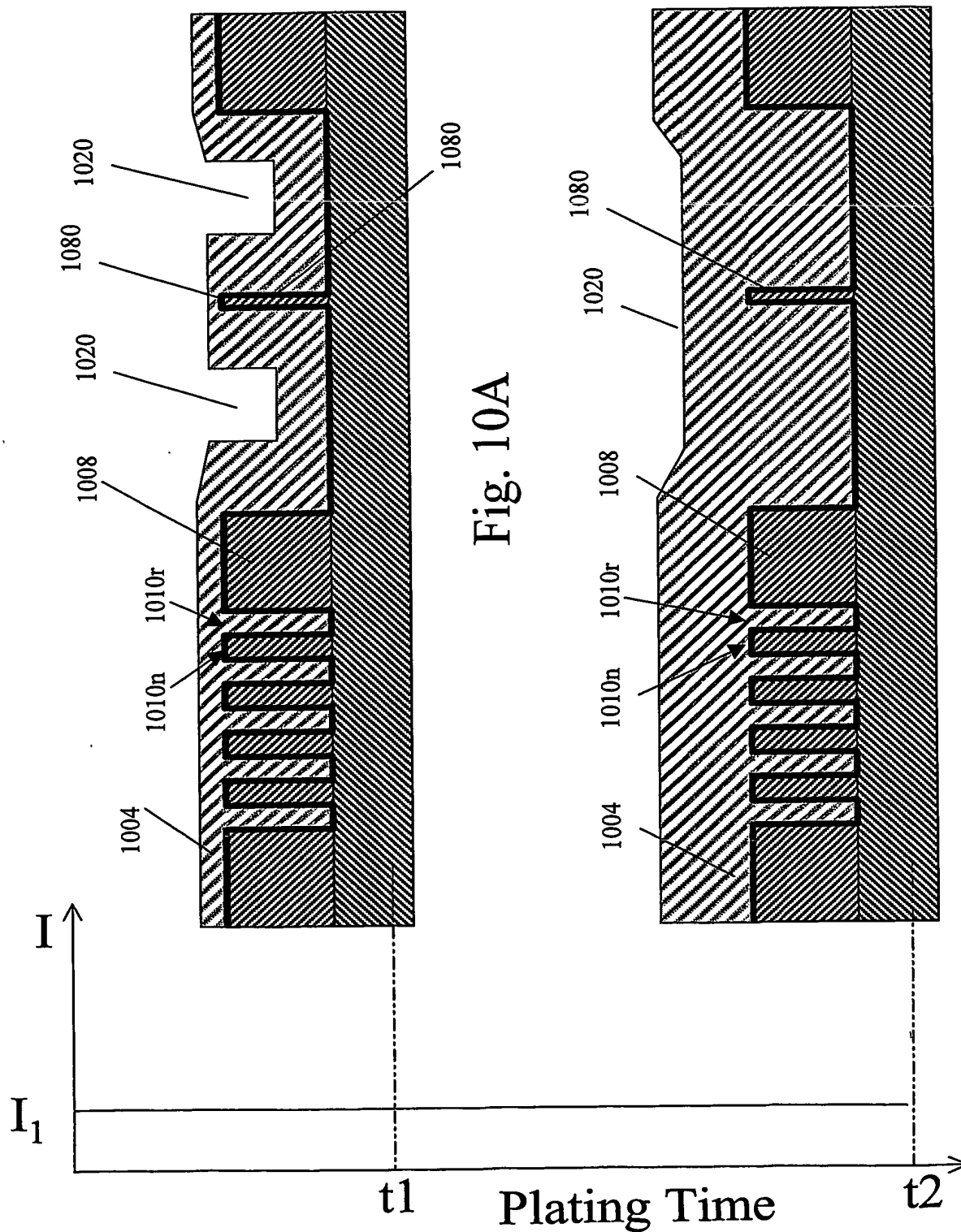
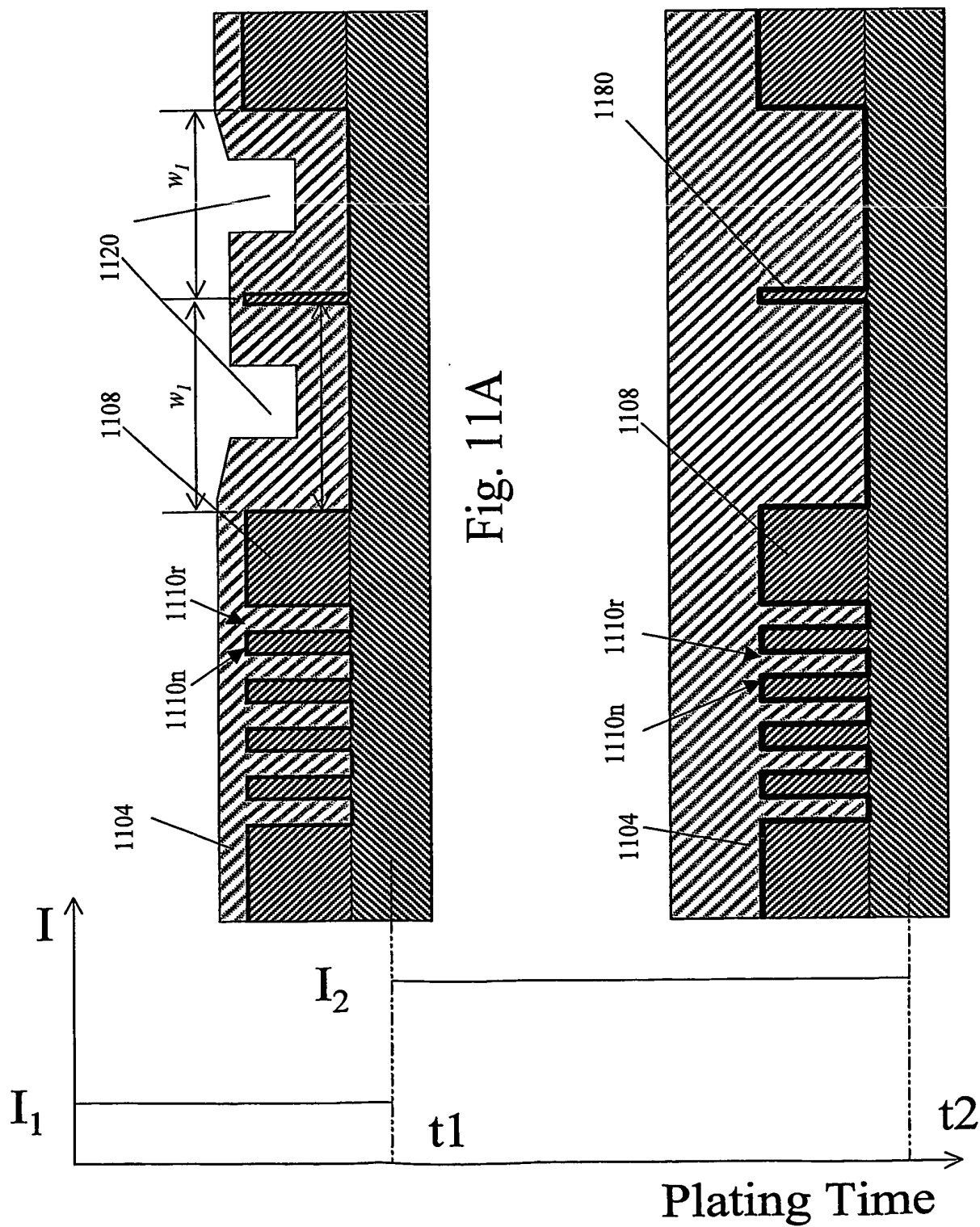
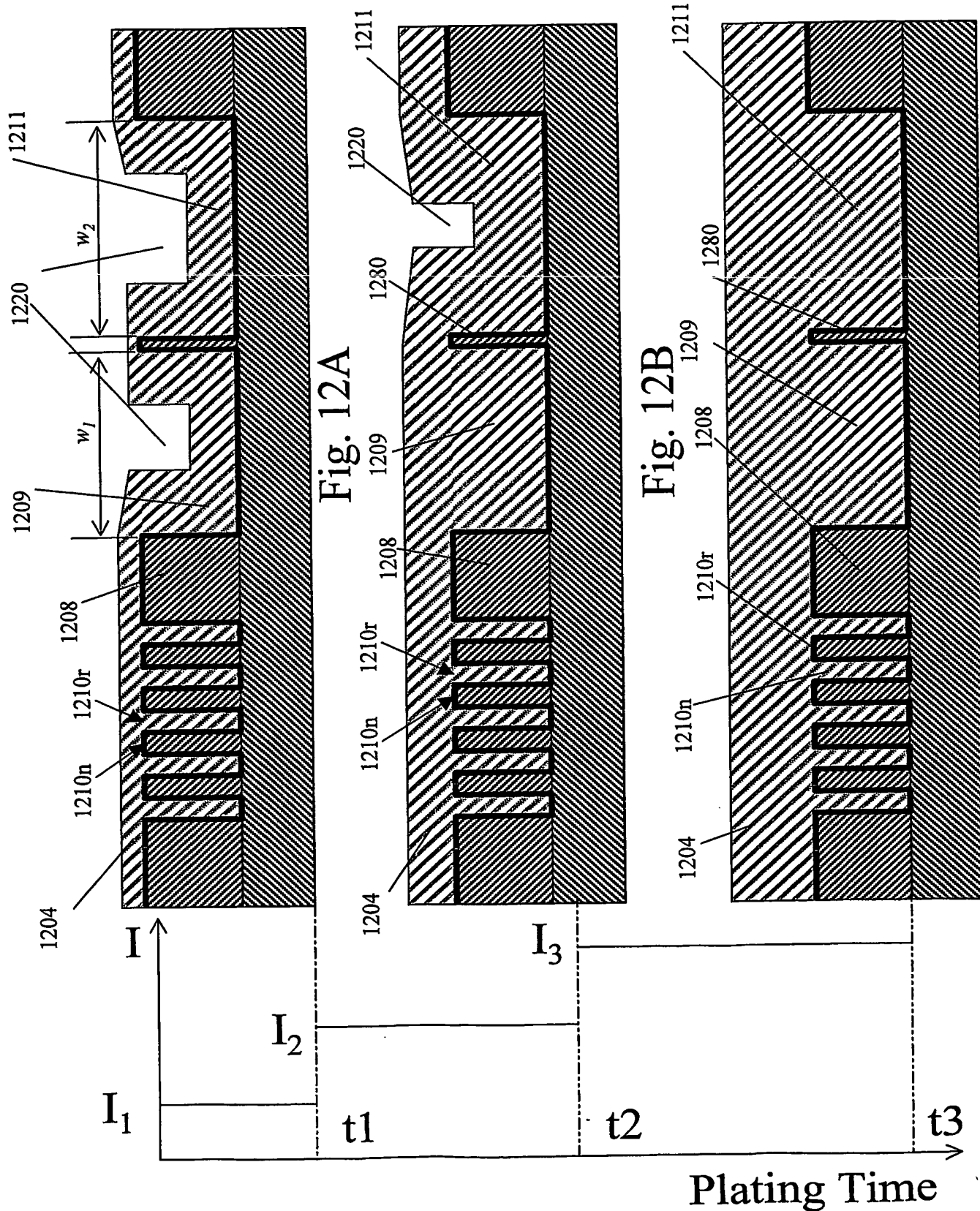


Fig. 10A

Fig. 10B





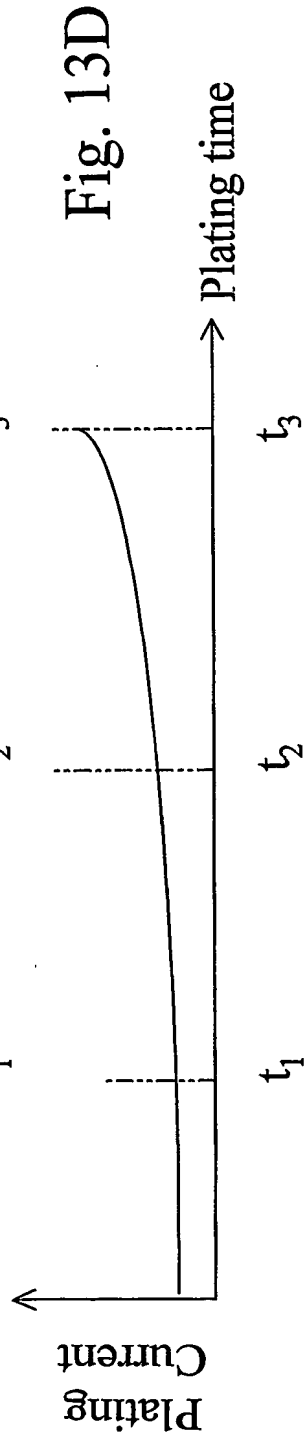
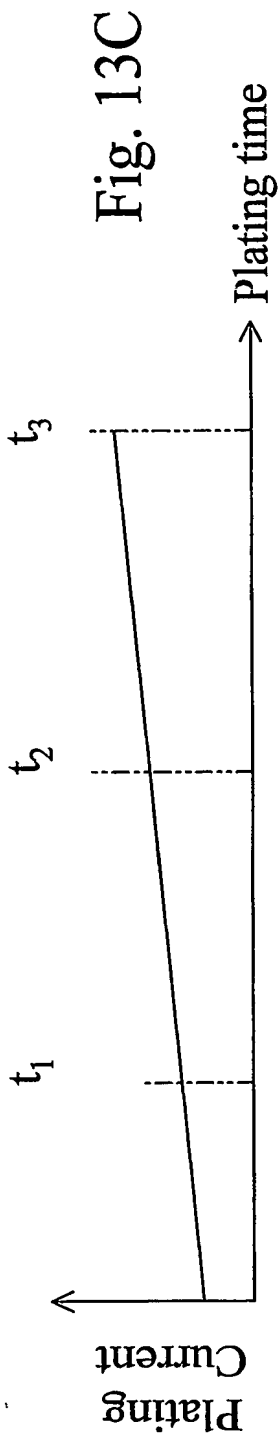
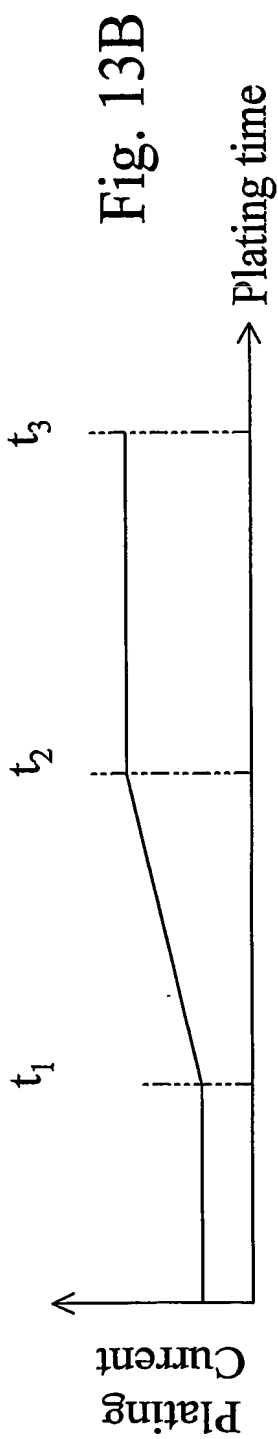
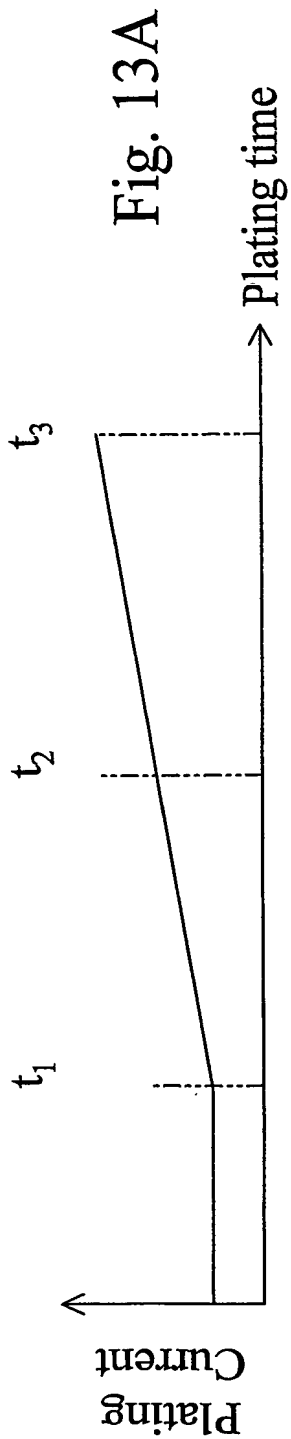


Fig. 13E

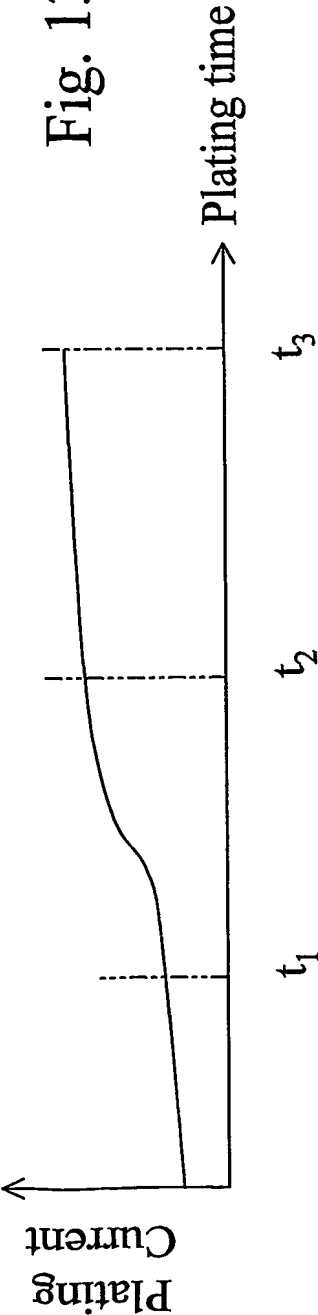


Fig. 13F

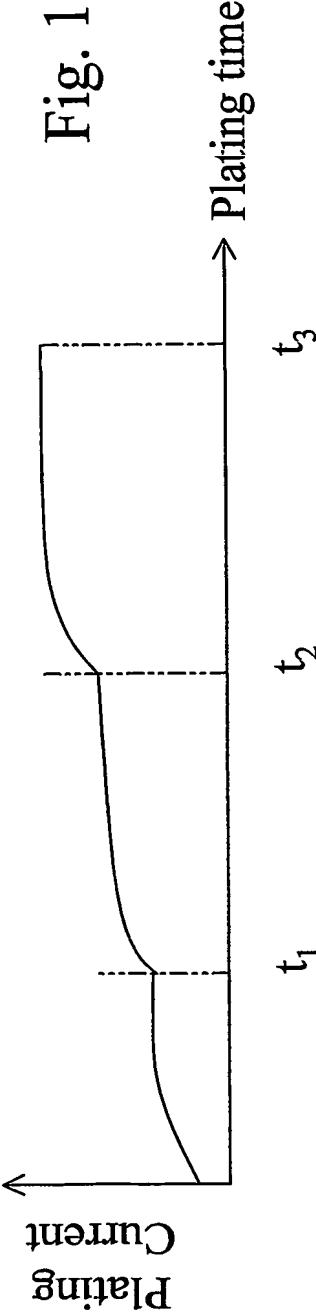


Fig. 13G

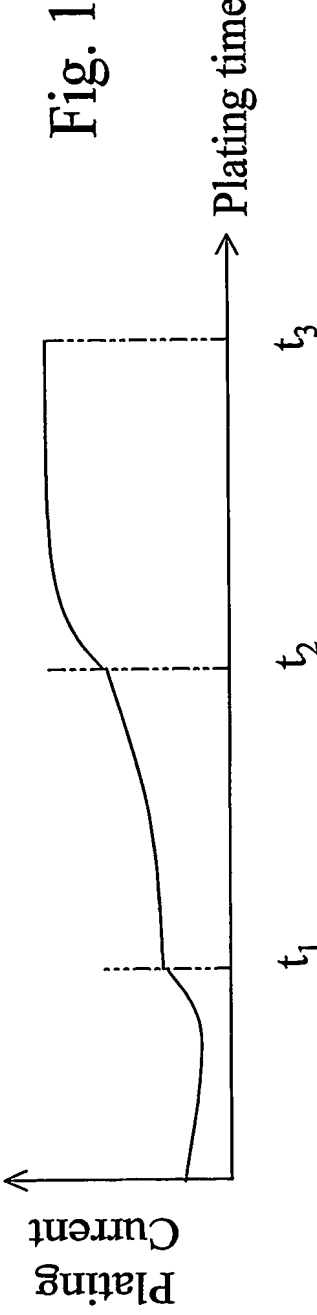
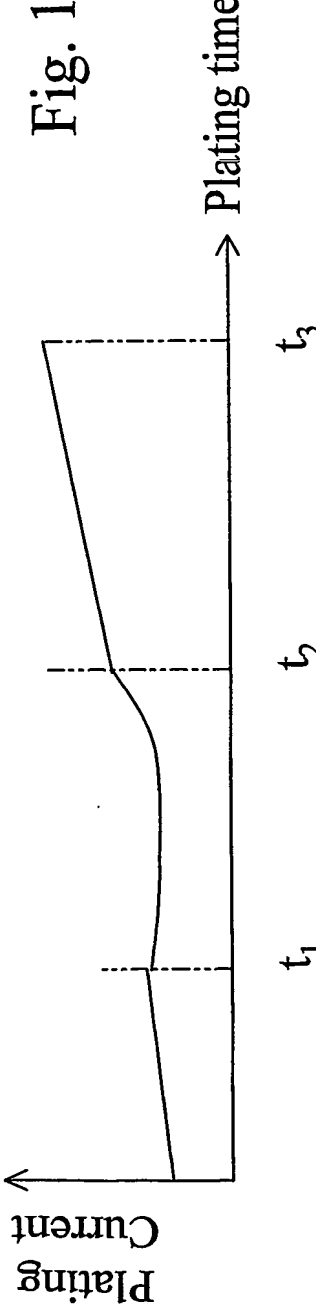


Fig. 13H



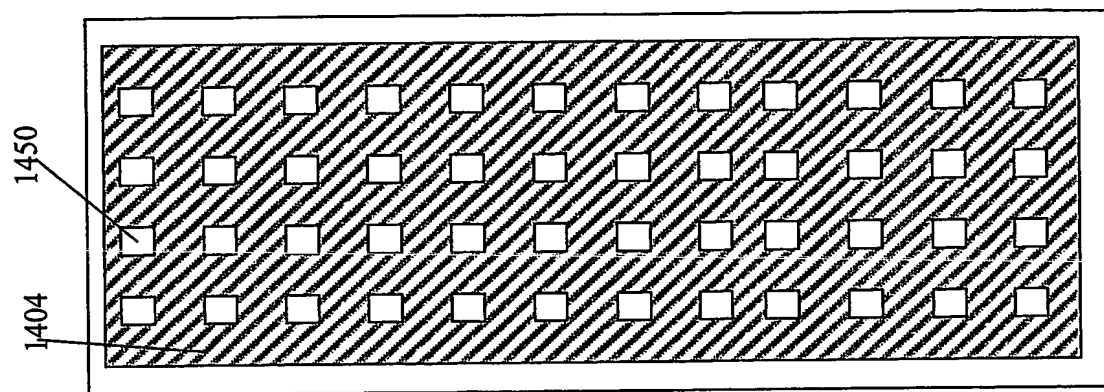


Fig. 14C

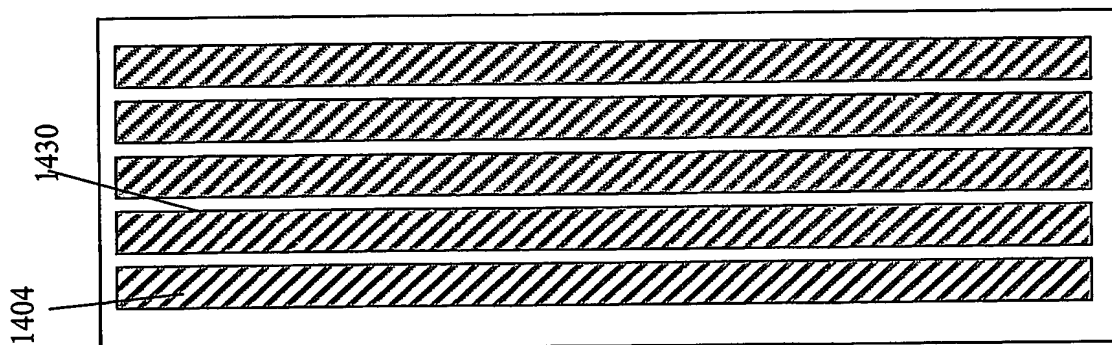


Fig. 14B

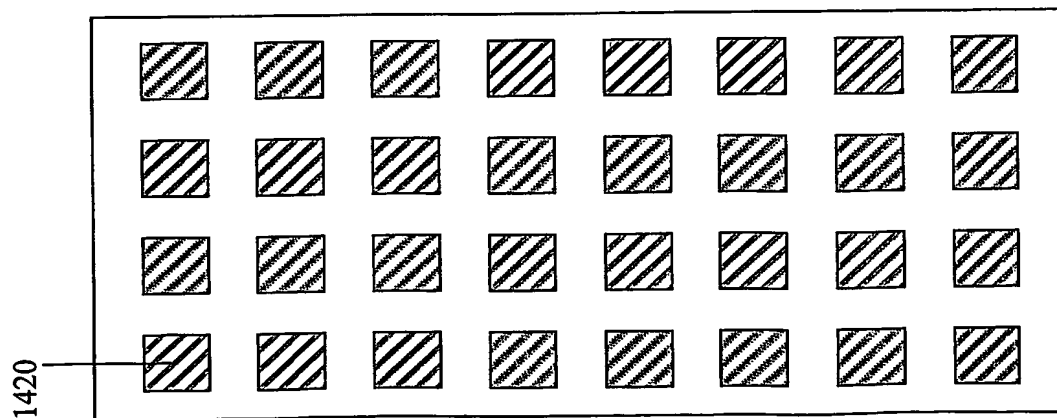


Fig. 14A

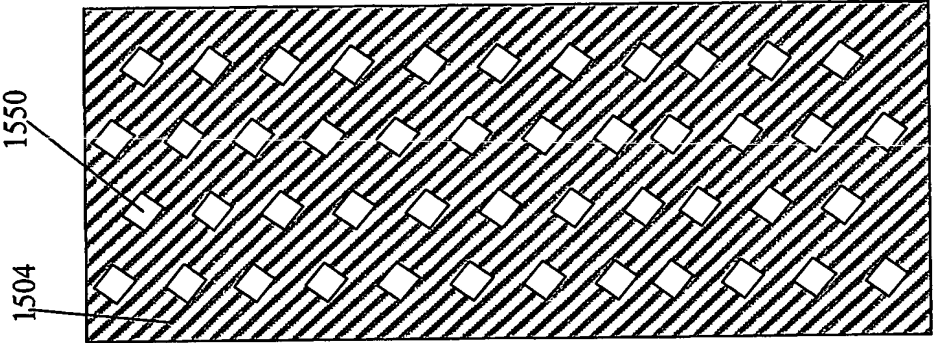


Fig. 15C

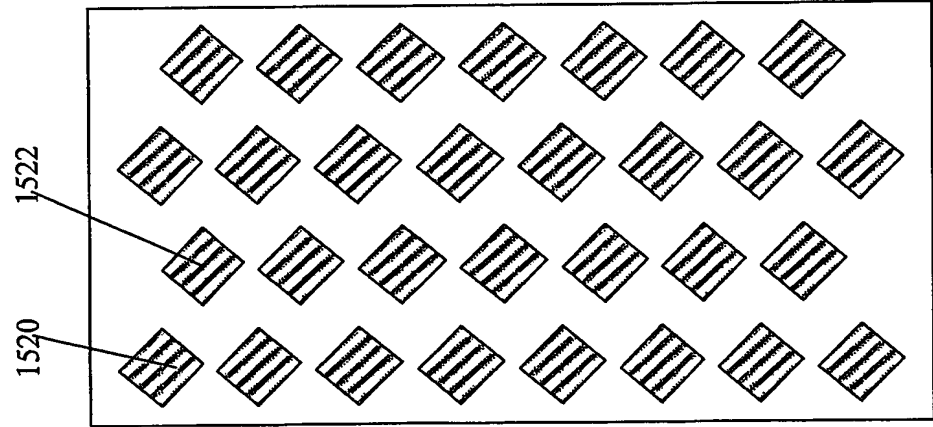


Fig. 15B

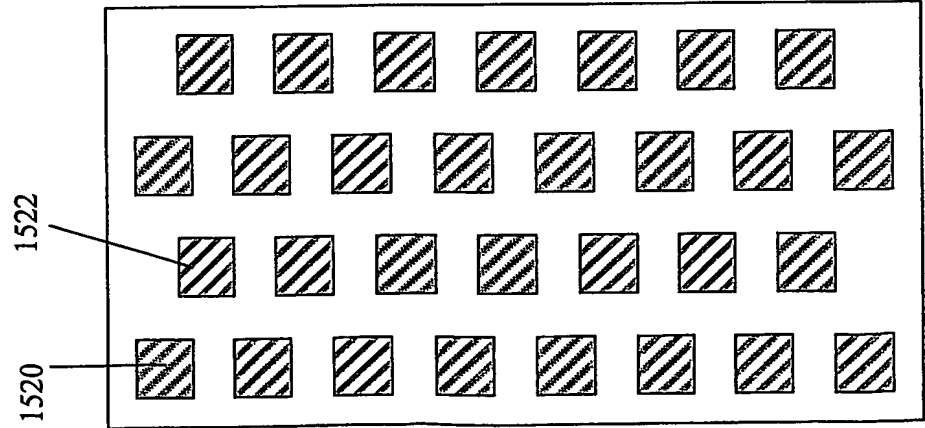


Fig. 15A

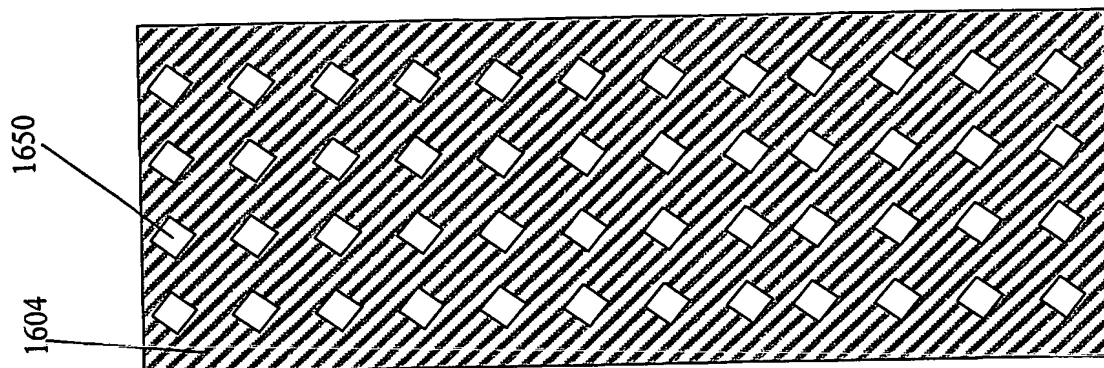


Fig. 16C

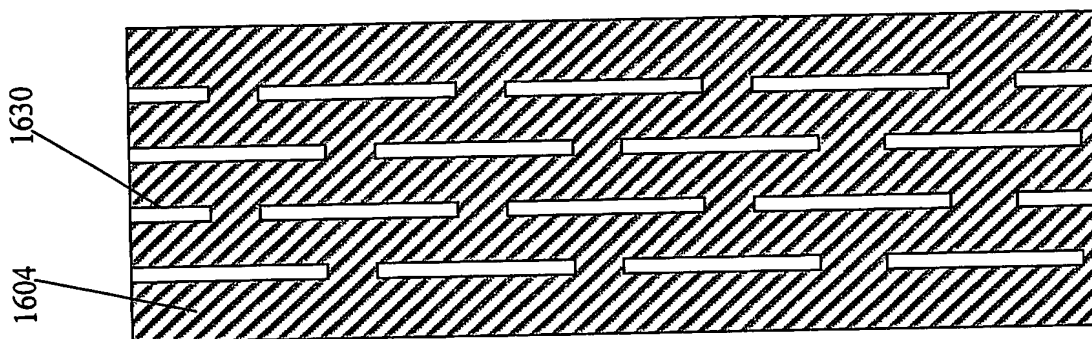


Fig. 16B

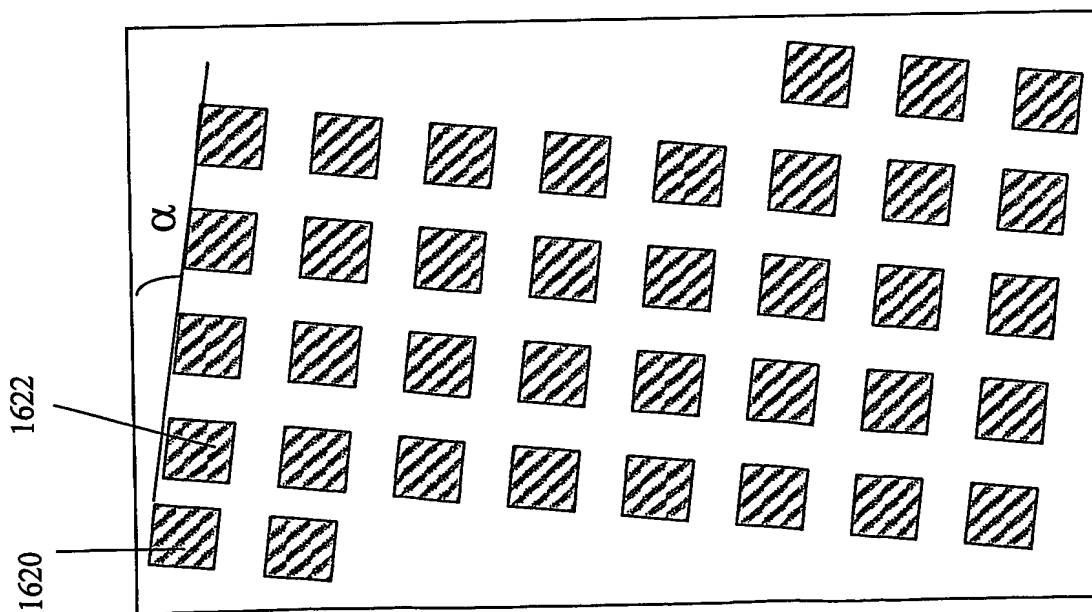


Fig. 16A

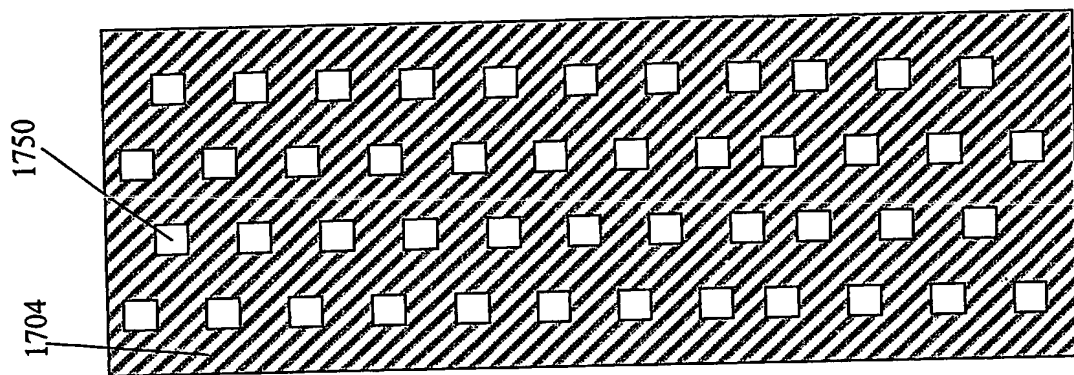


Fig. 17C

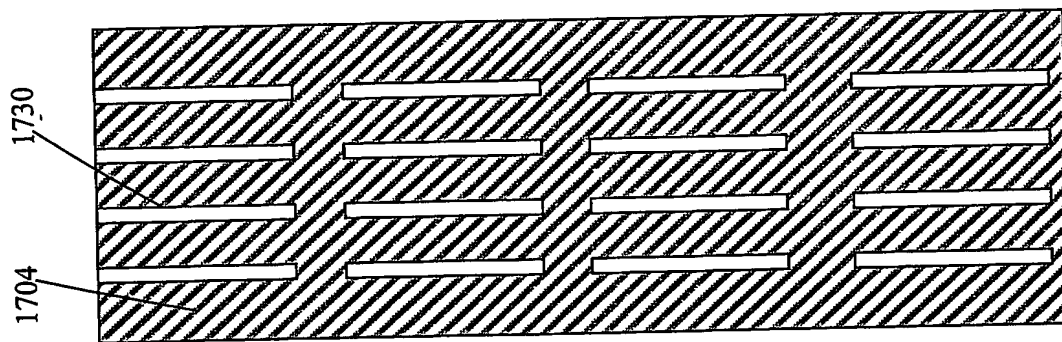


Fig. 17B

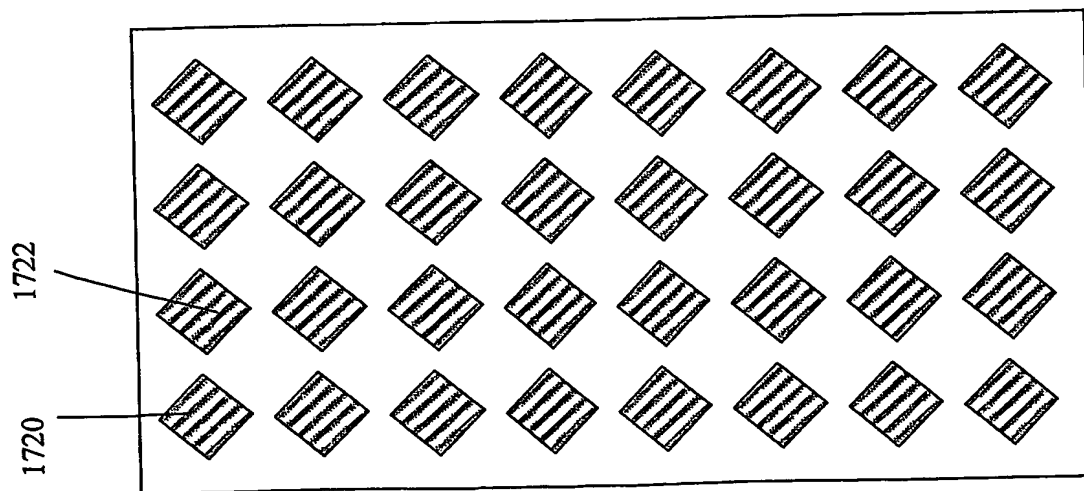


Fig. 17A

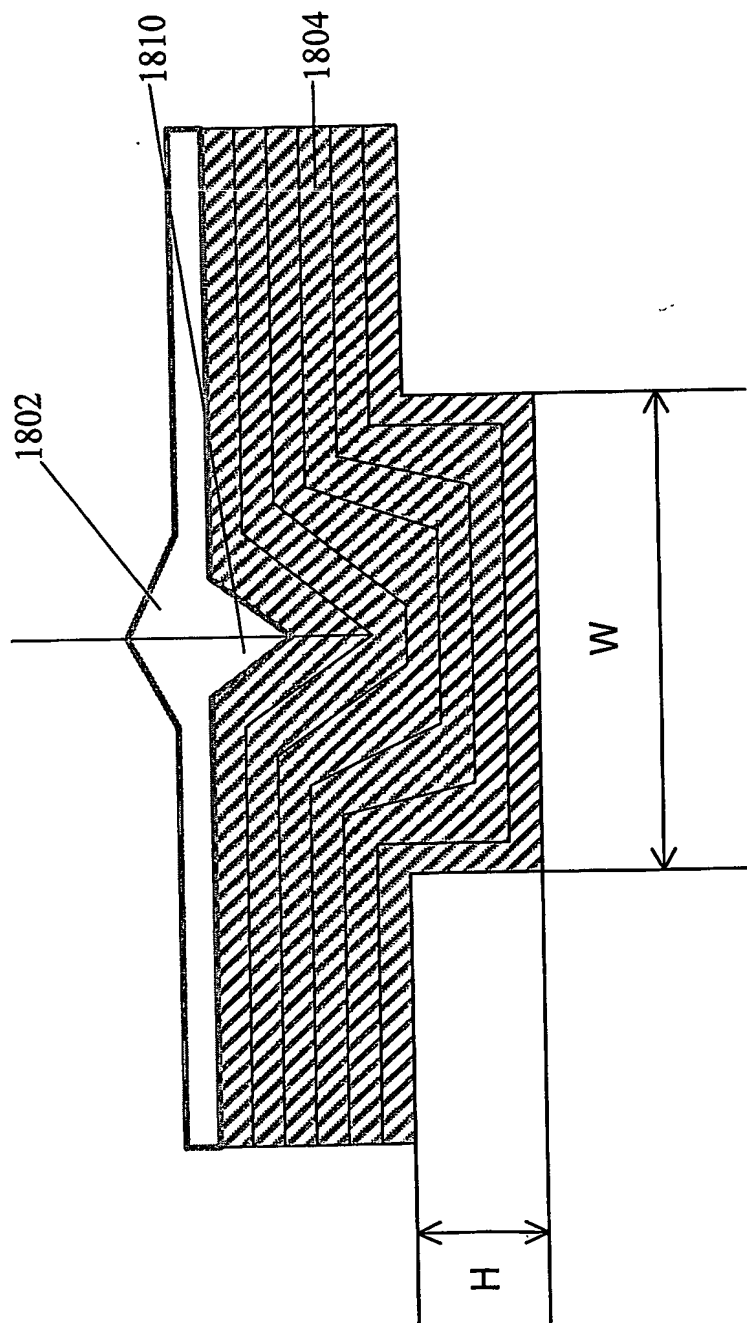


Fig. 18A

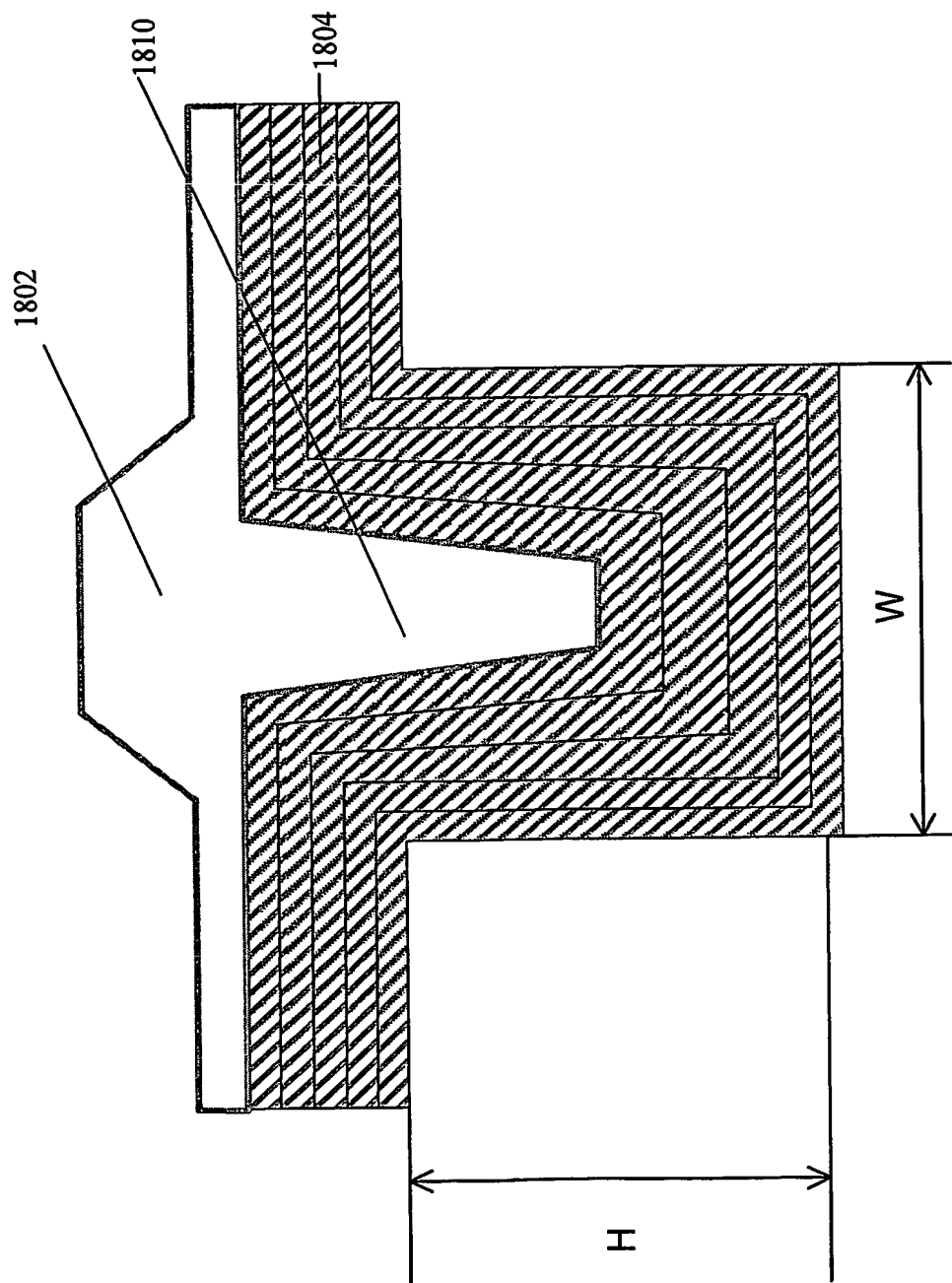


Fig. 18B

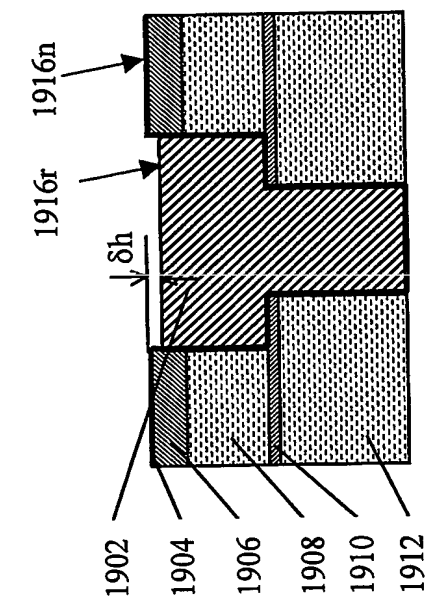


Fig. 19C

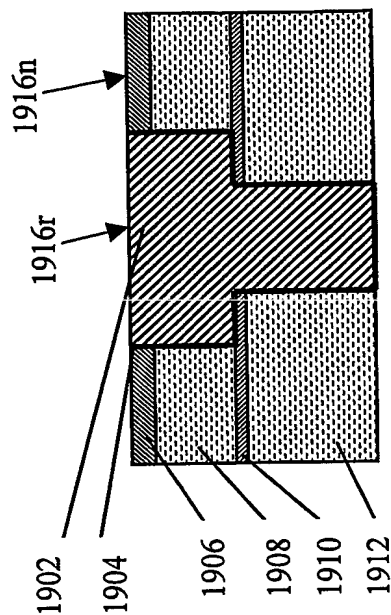


Fig. 19D

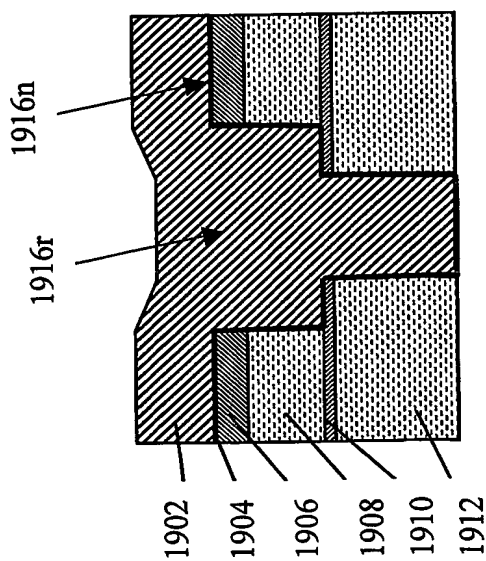


Fig. 19A

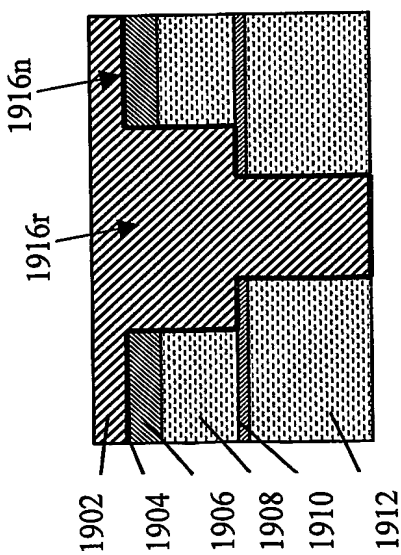


Fig. 19B

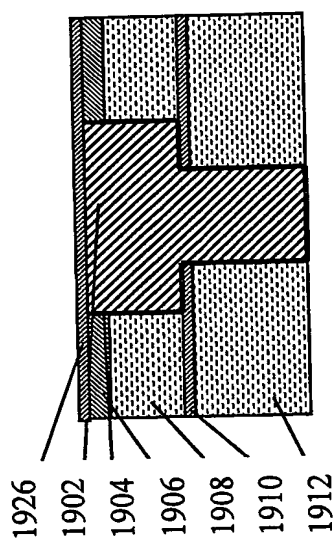


Fig. 19E

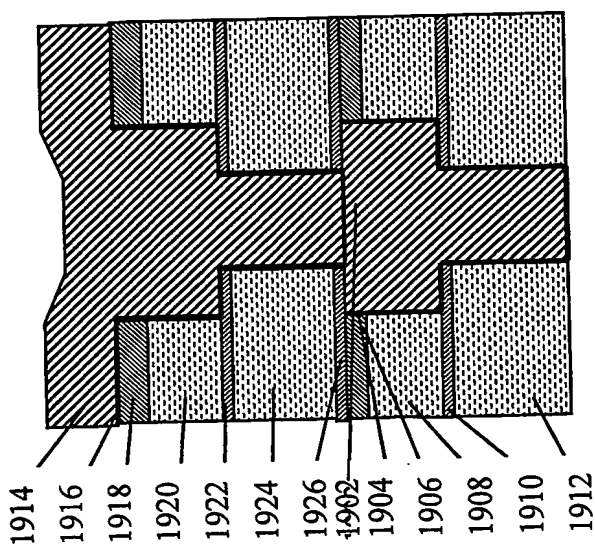


Fig. 19F

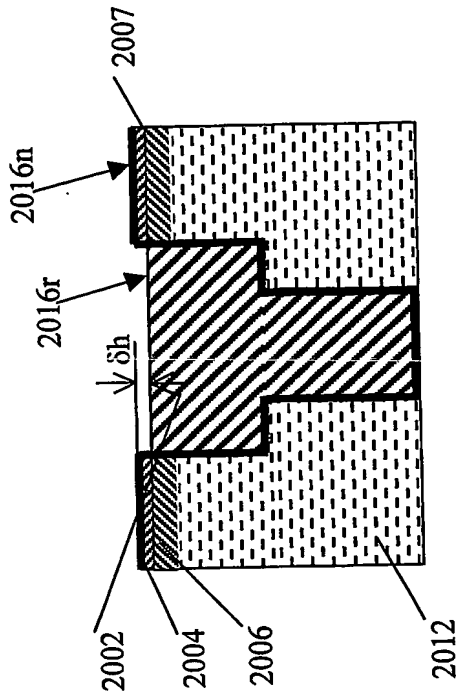


Fig. 20C

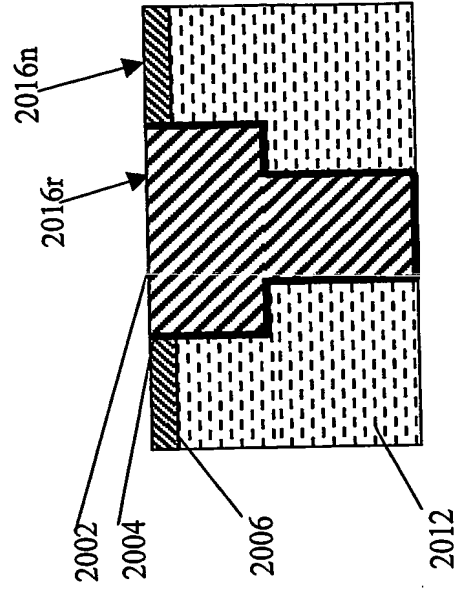


Fig. 20D

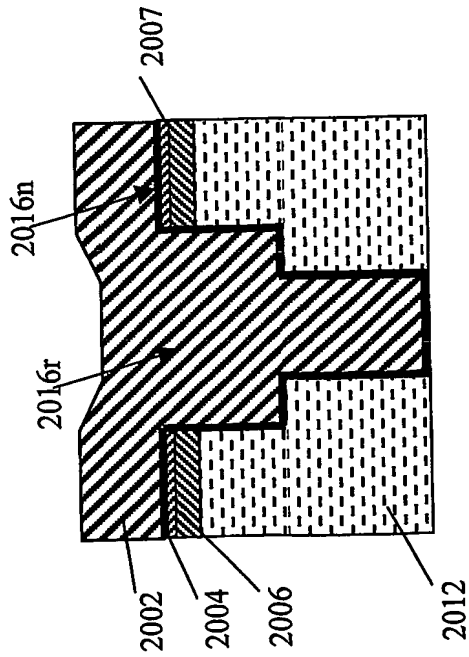


Fig. 20A

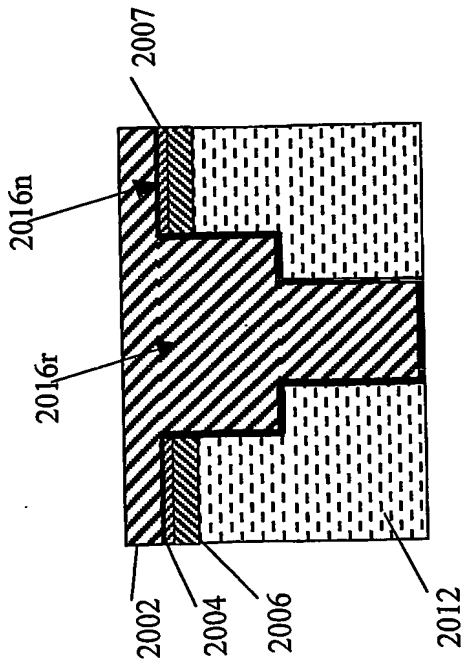
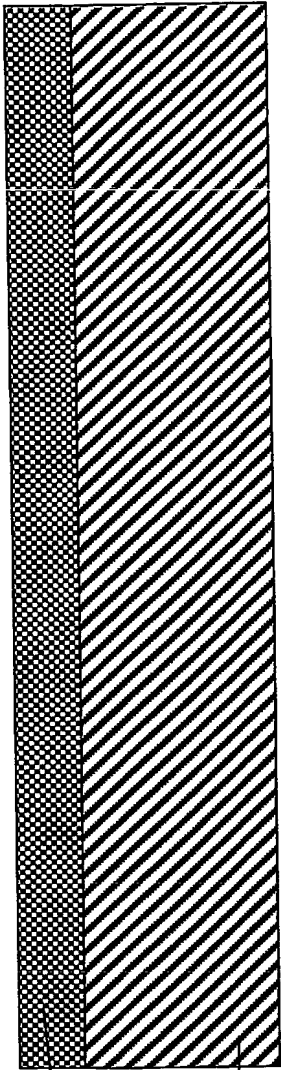


Fig. 20B

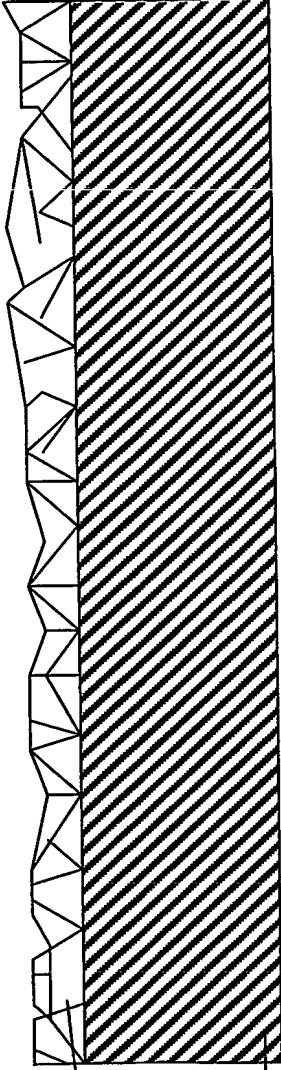
Fig. 21A



2102

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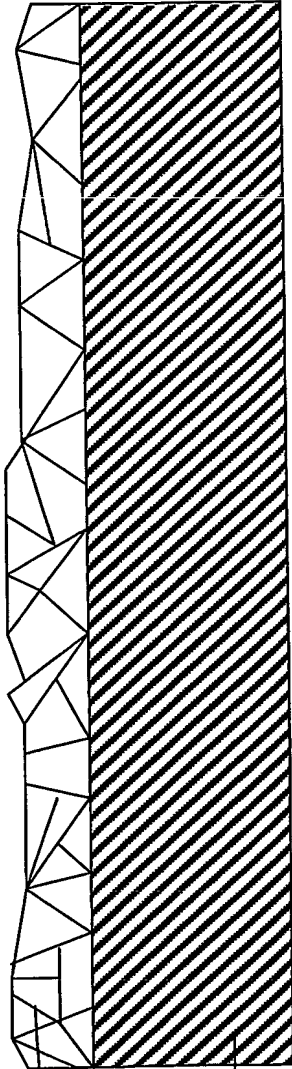
Fig. 21B



2104

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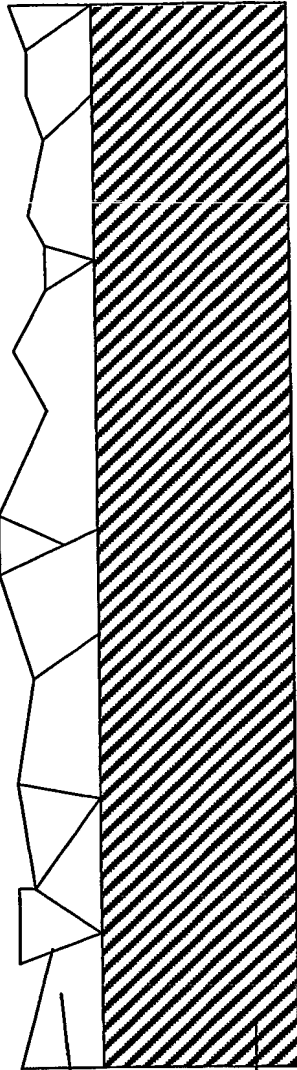
Fig. 21C



2106

2100

Fig. 21D



2108

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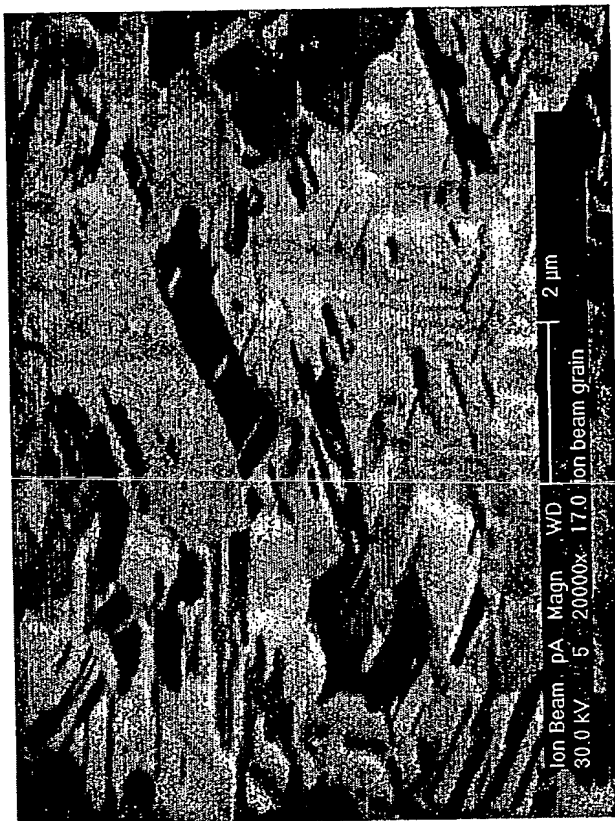


Fig. 22B



Fig. 22A

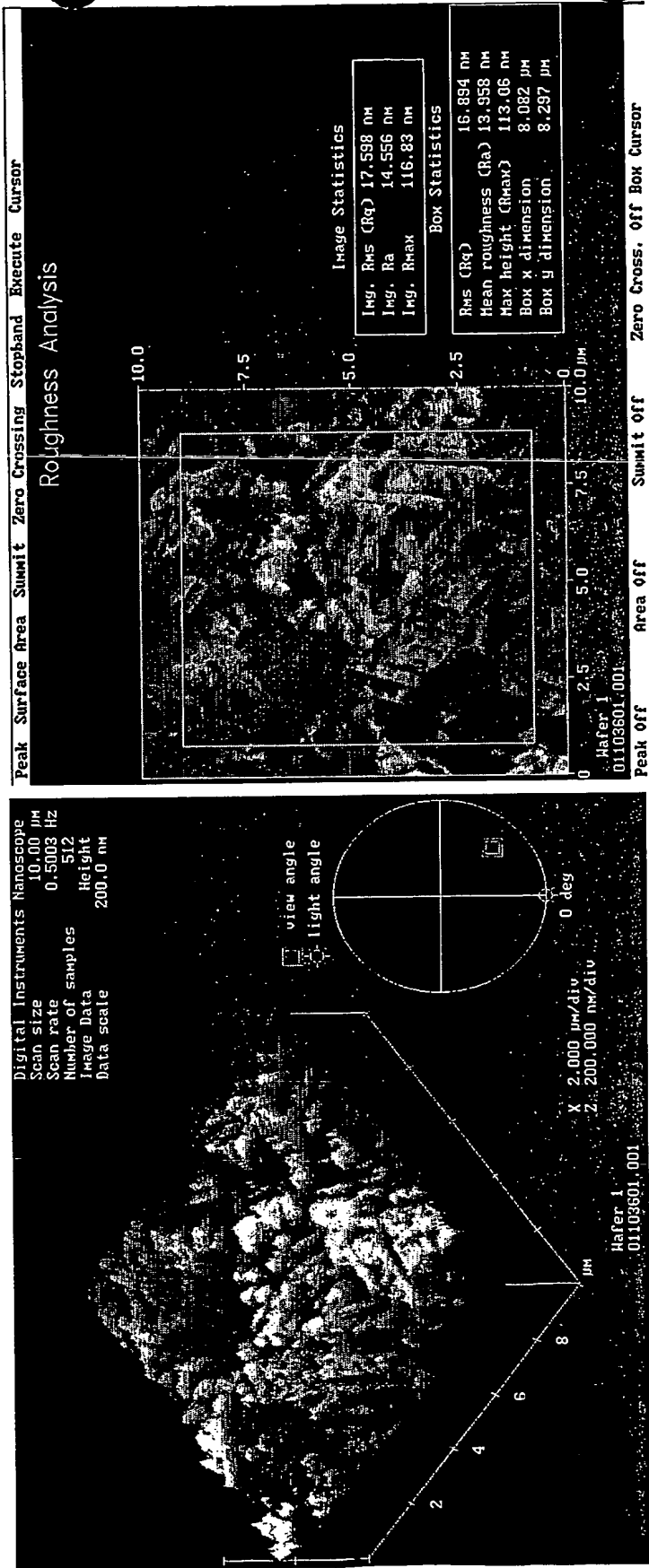


Fig. 22C

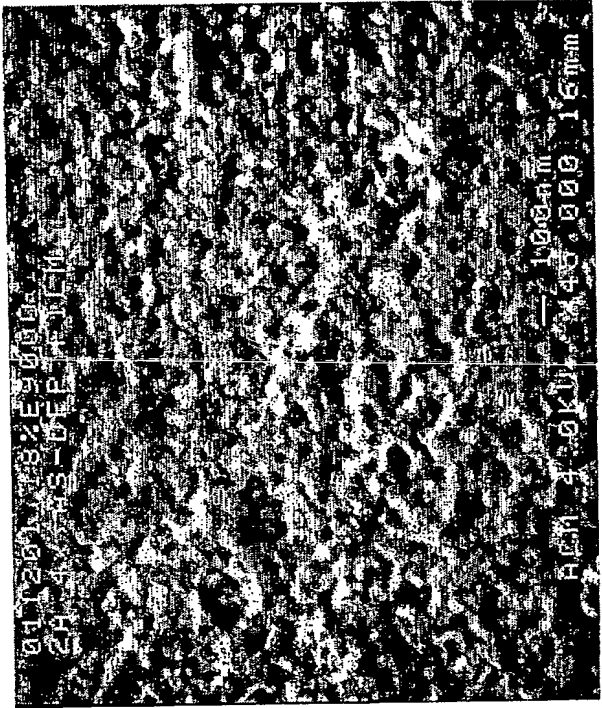


Fig. 23B

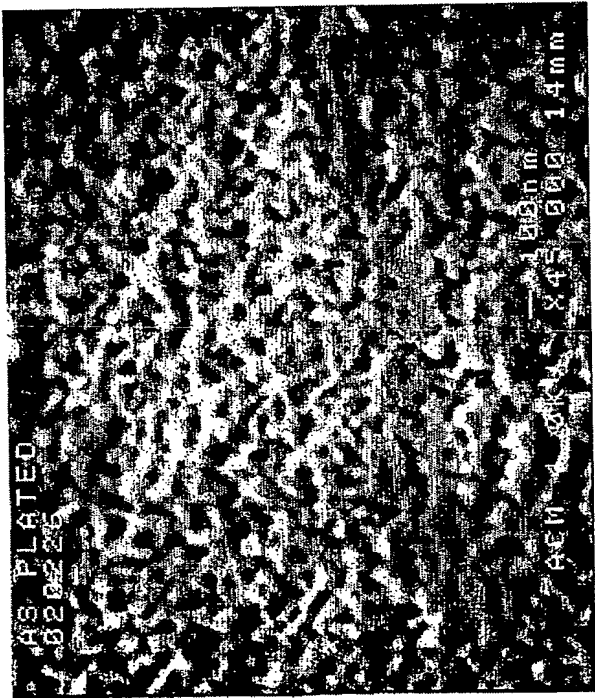


Fig. 23A

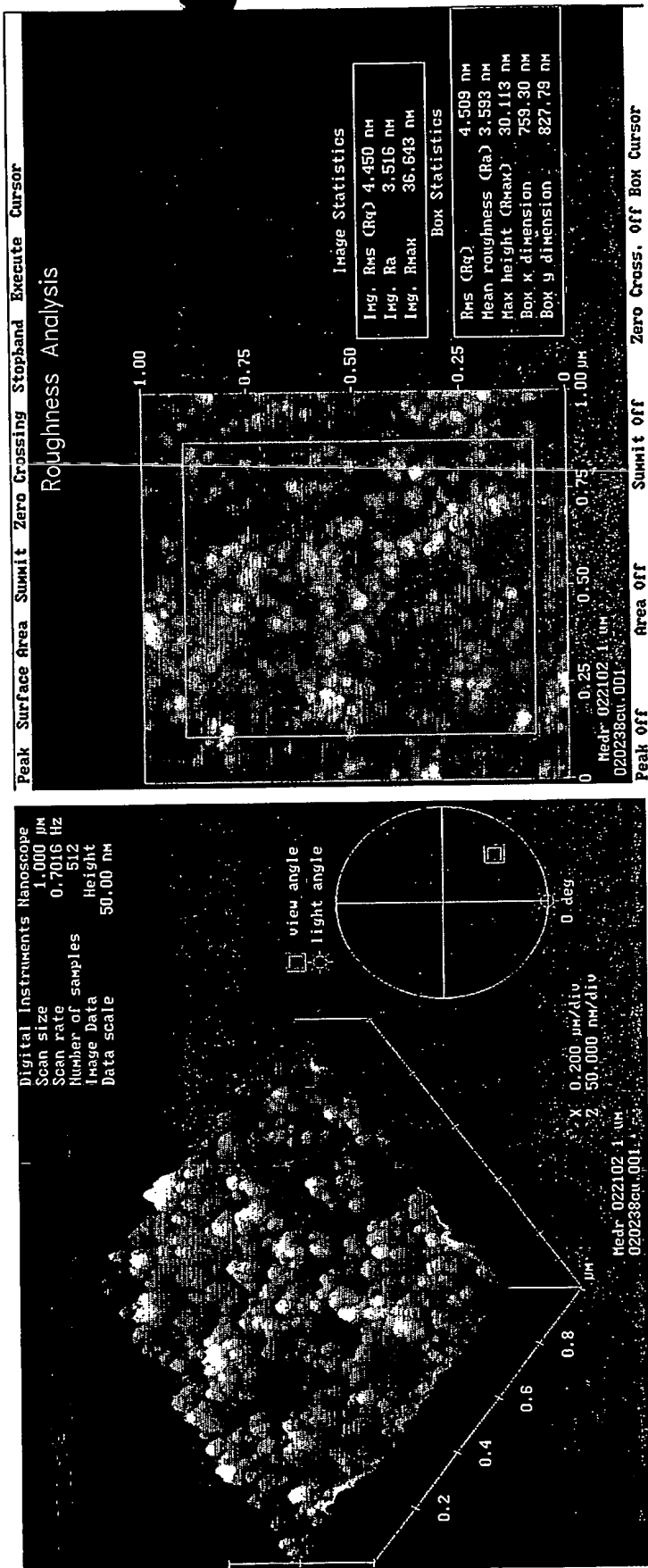


Fig. 23C

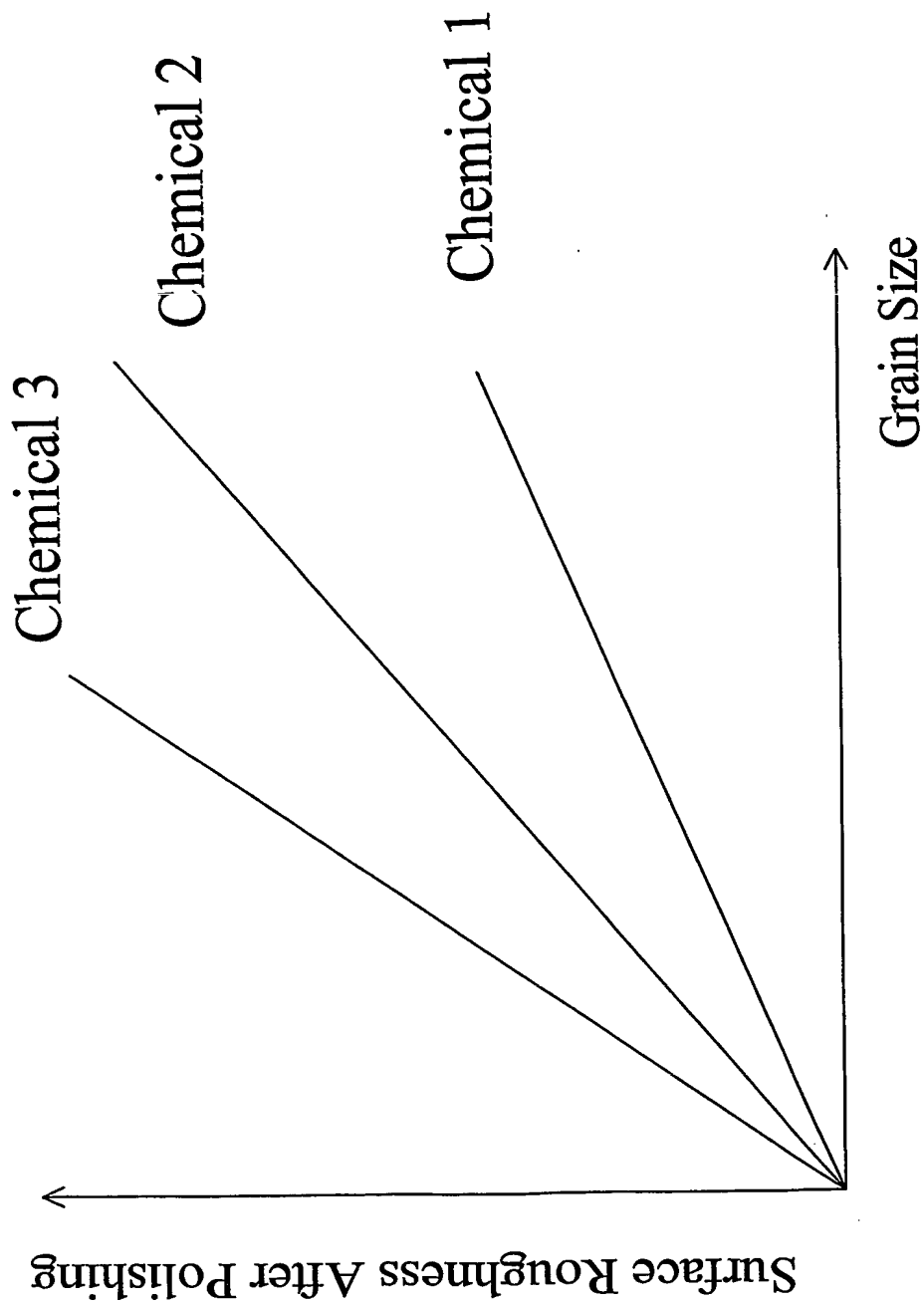


Fig. 24

Fig. 25A

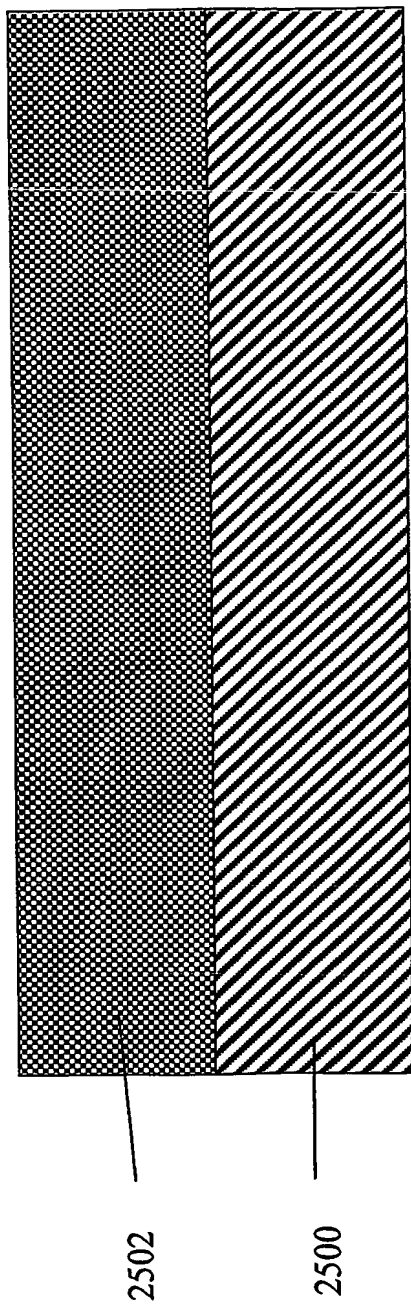


Fig. 25B

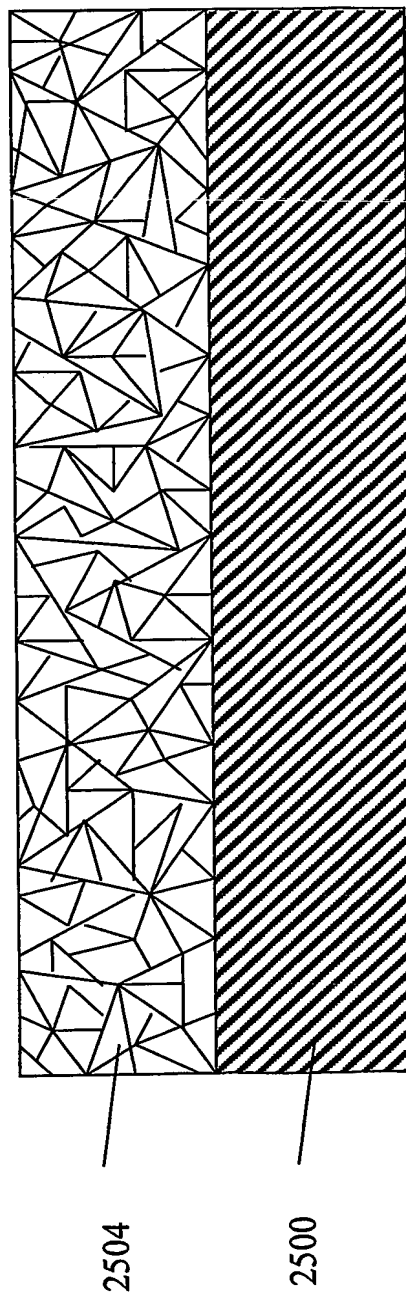


Fig. 25C

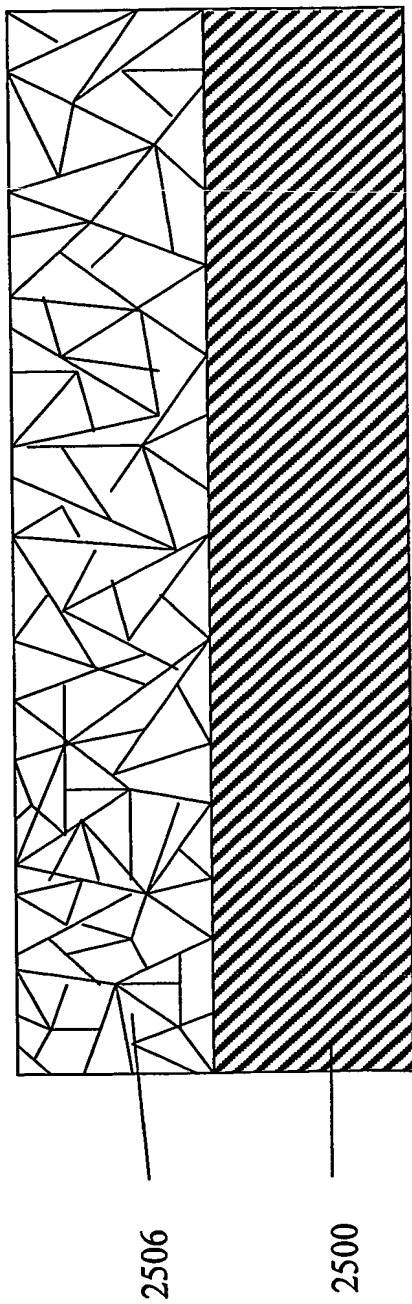
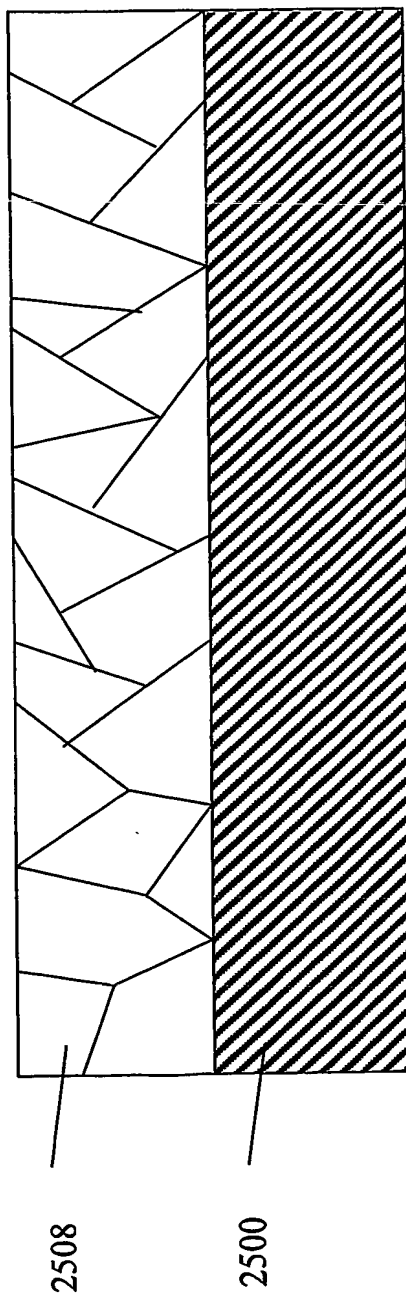


Fig. 25D



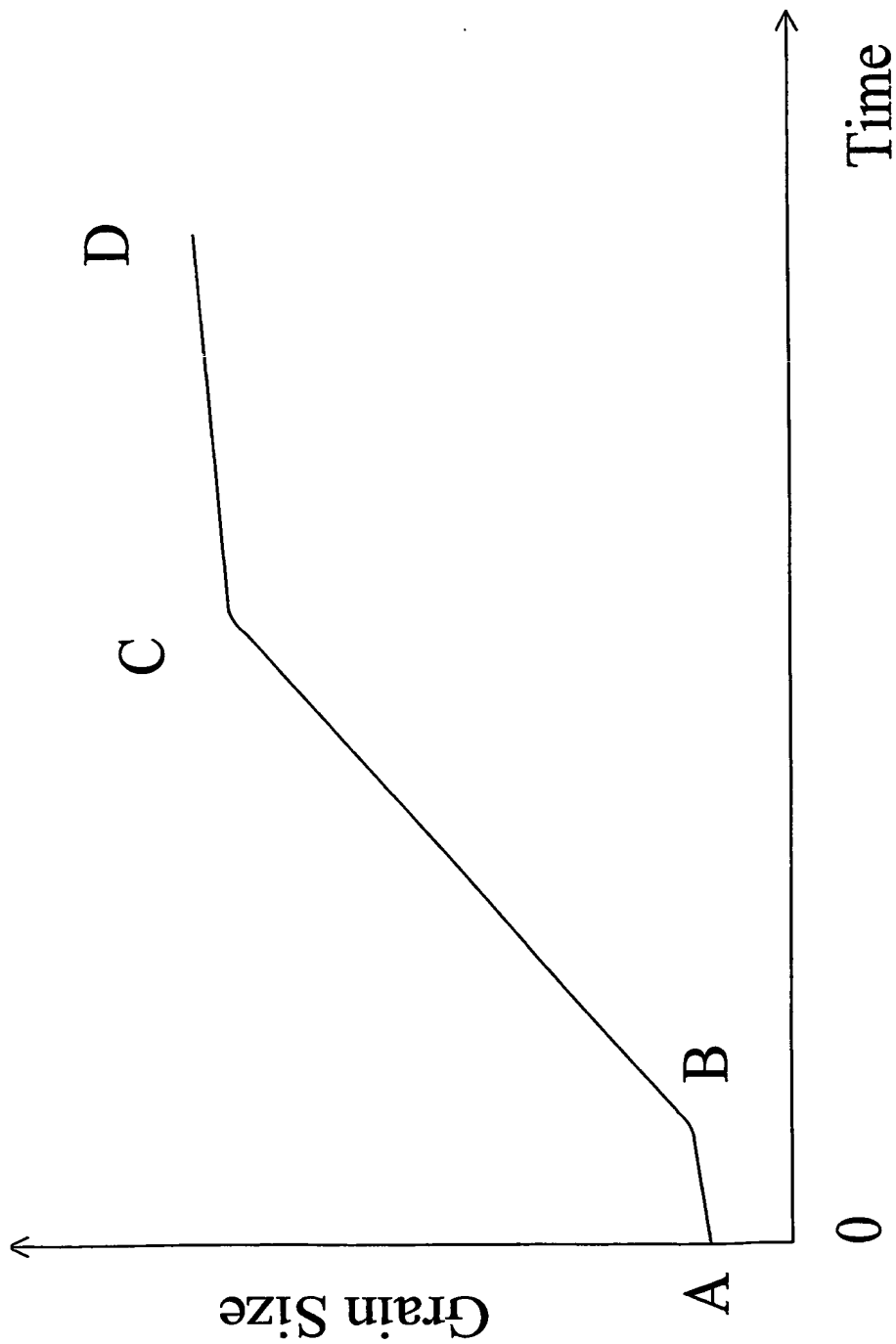


Fig. 26

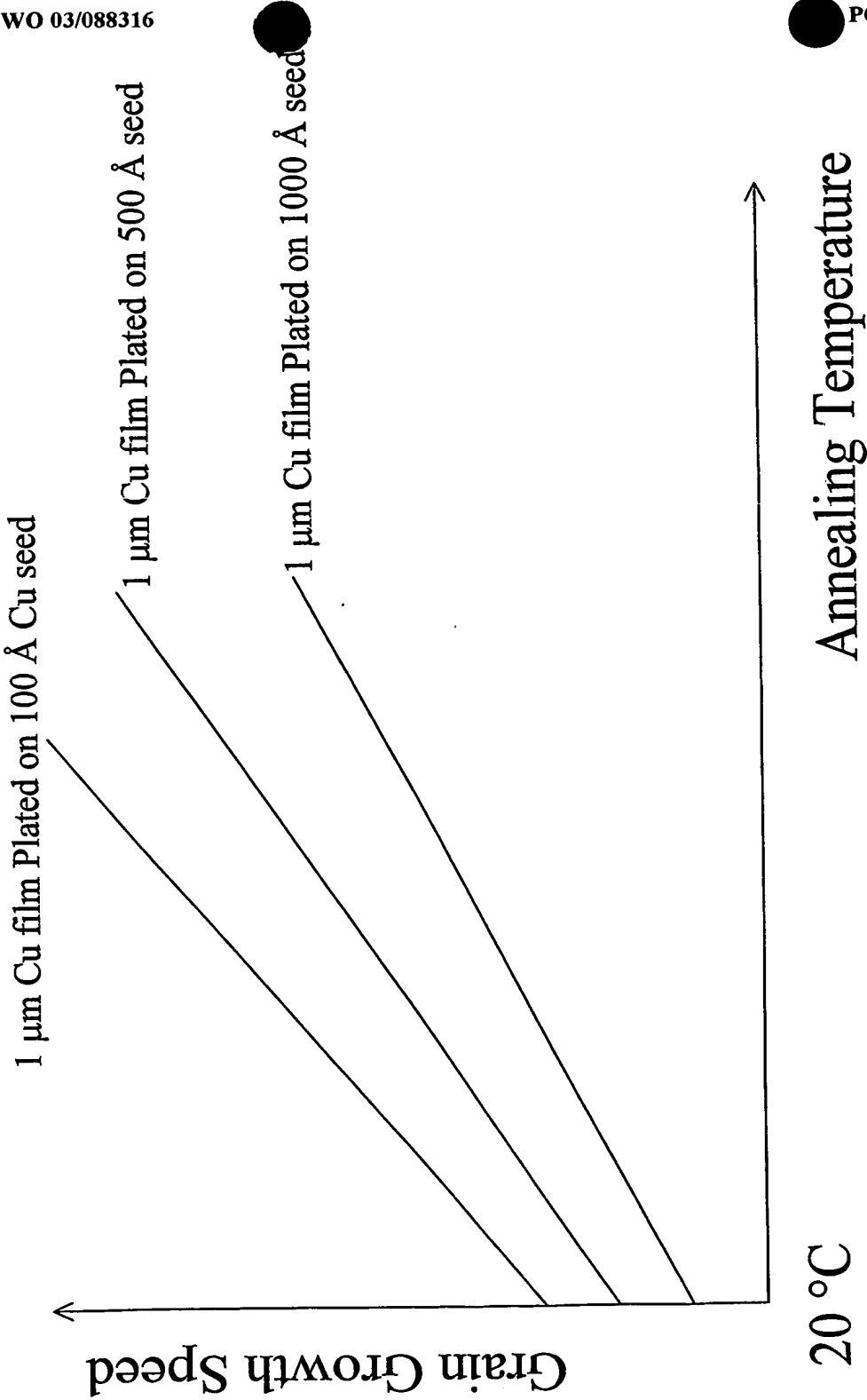


Fig. 27

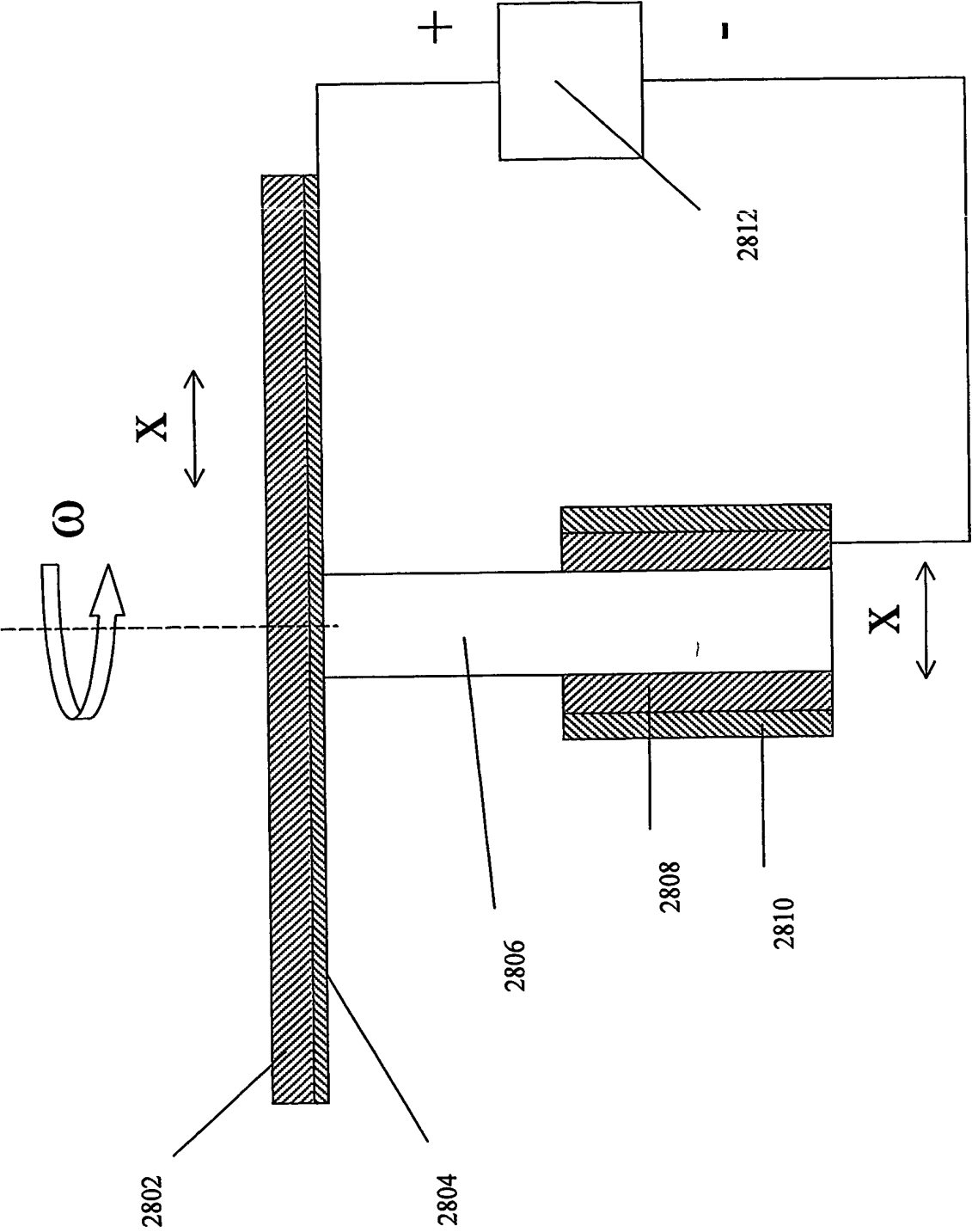


Fig. 28A

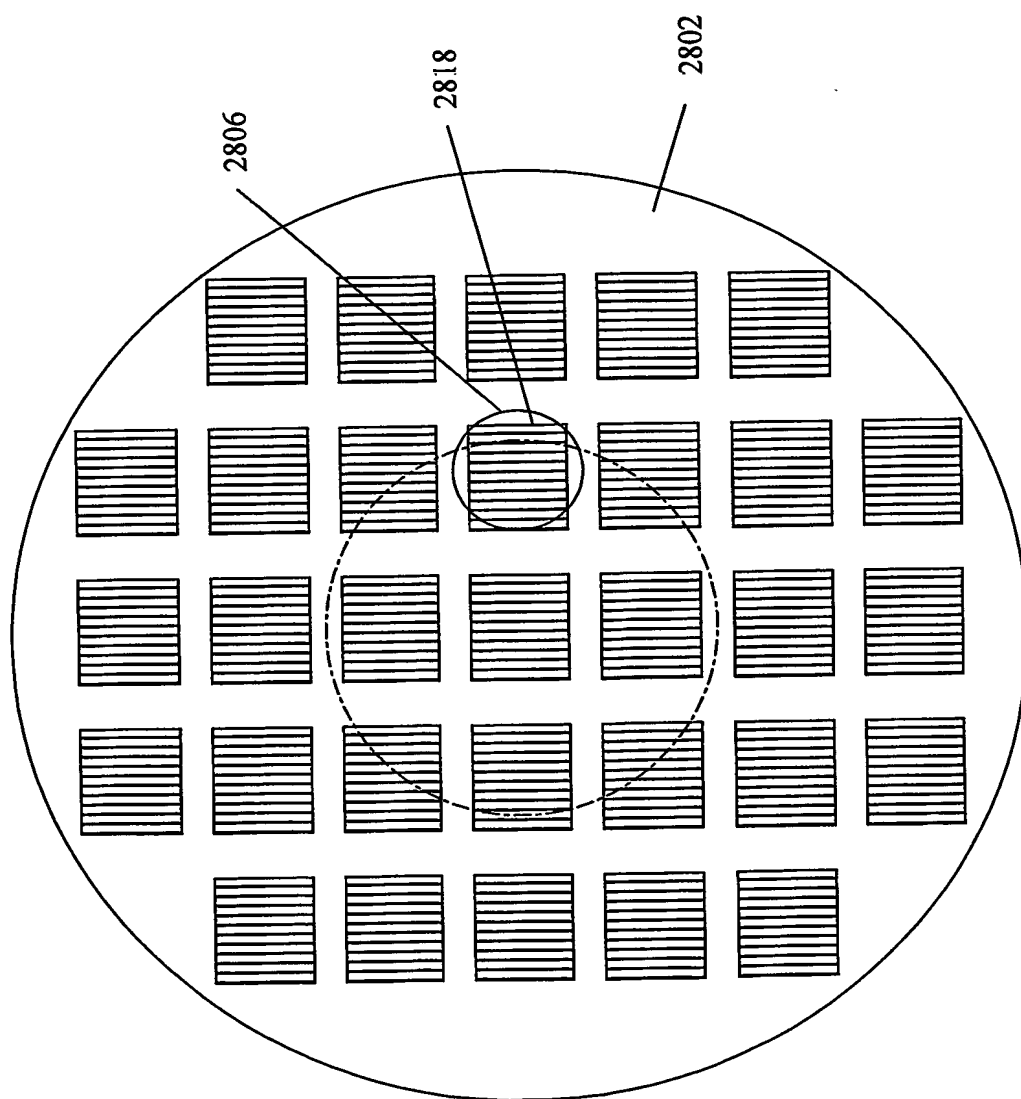


Fig. 28B

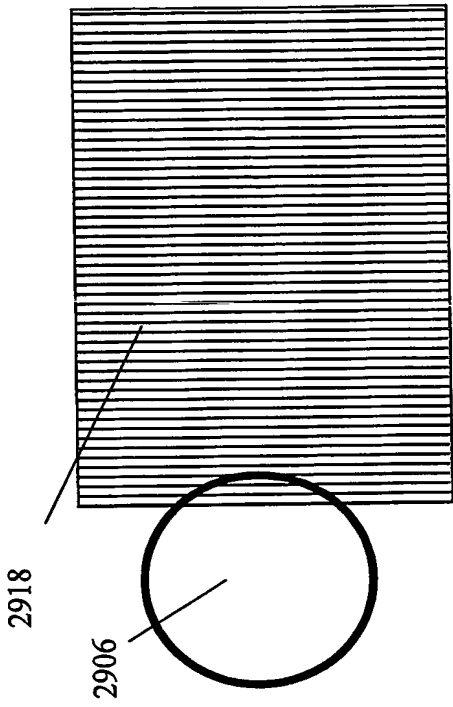


Fig. 29A

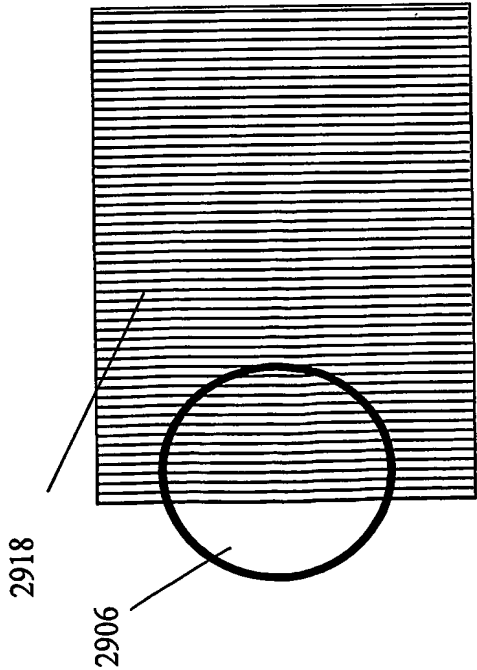


Fig. 29B

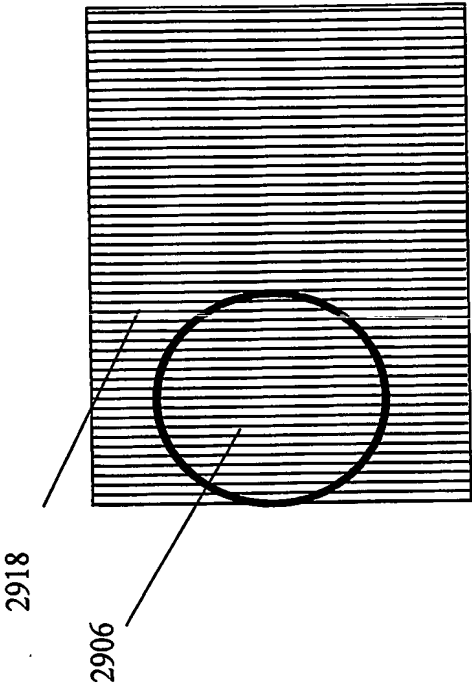
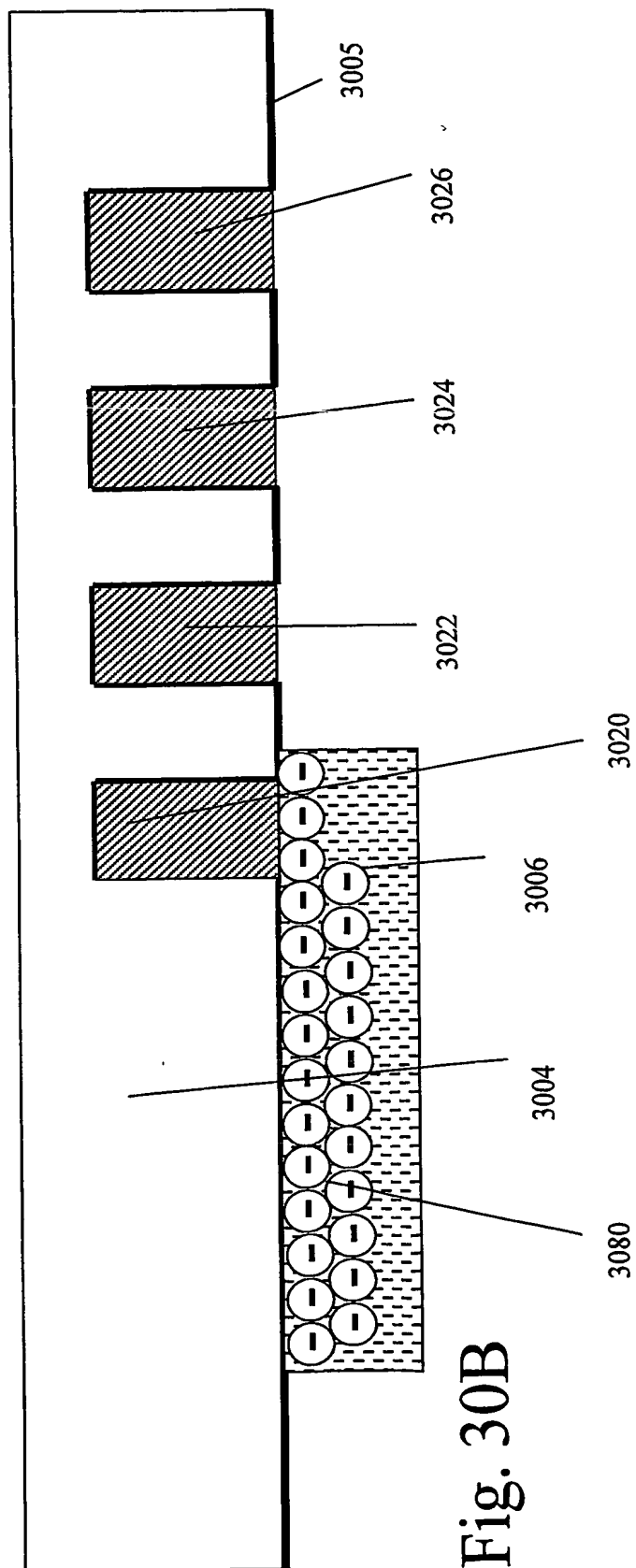
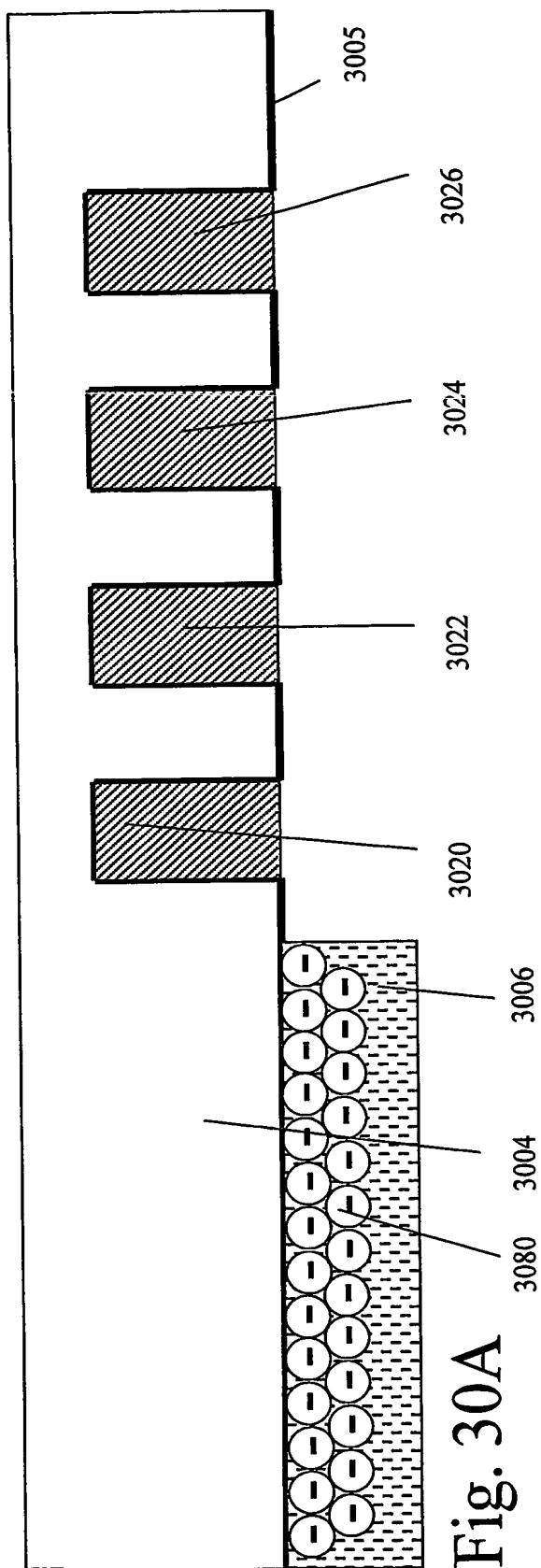
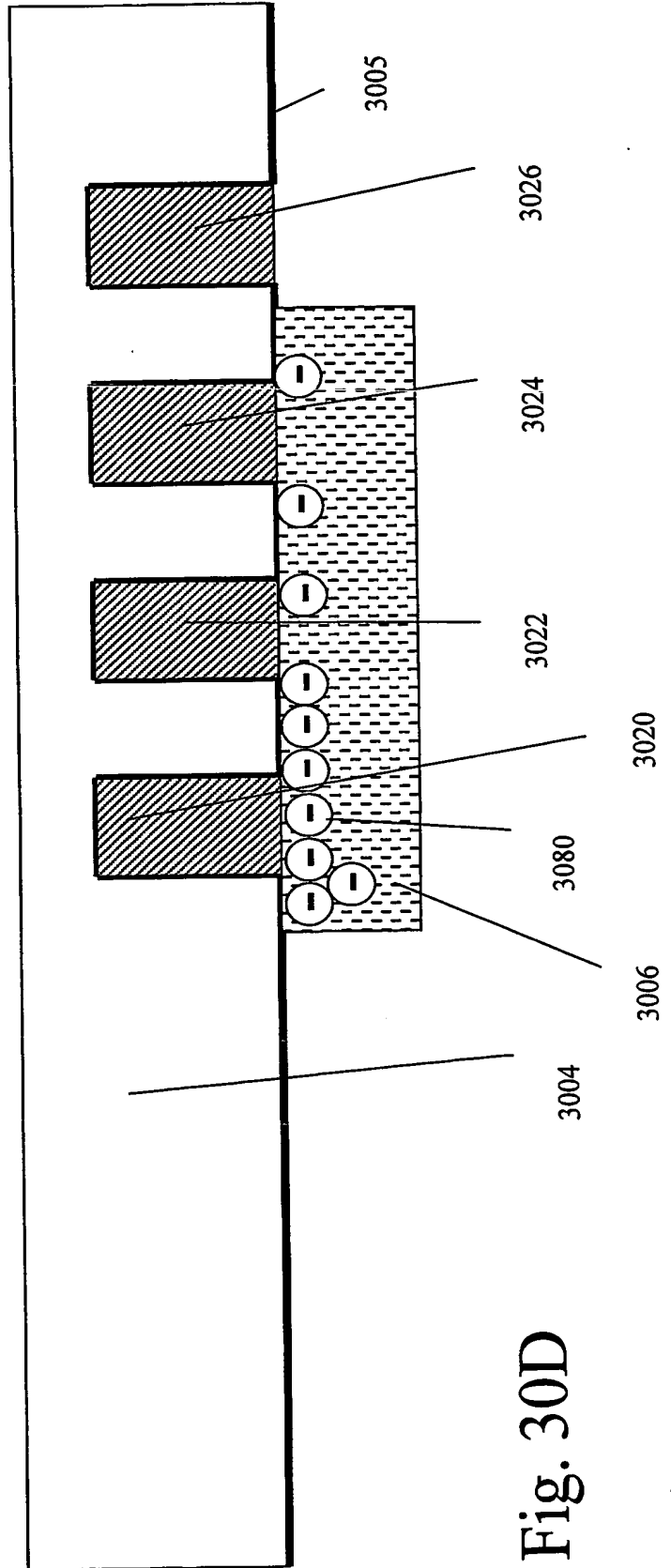
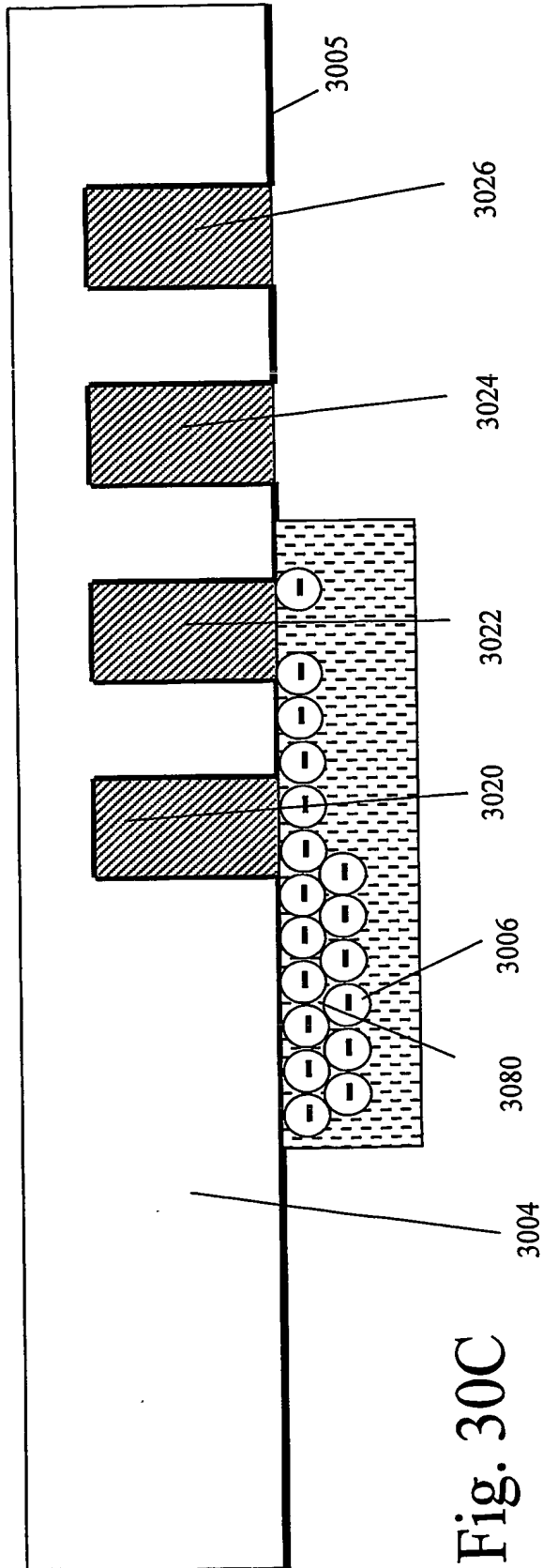


Fig. 29C

Fig. 29D





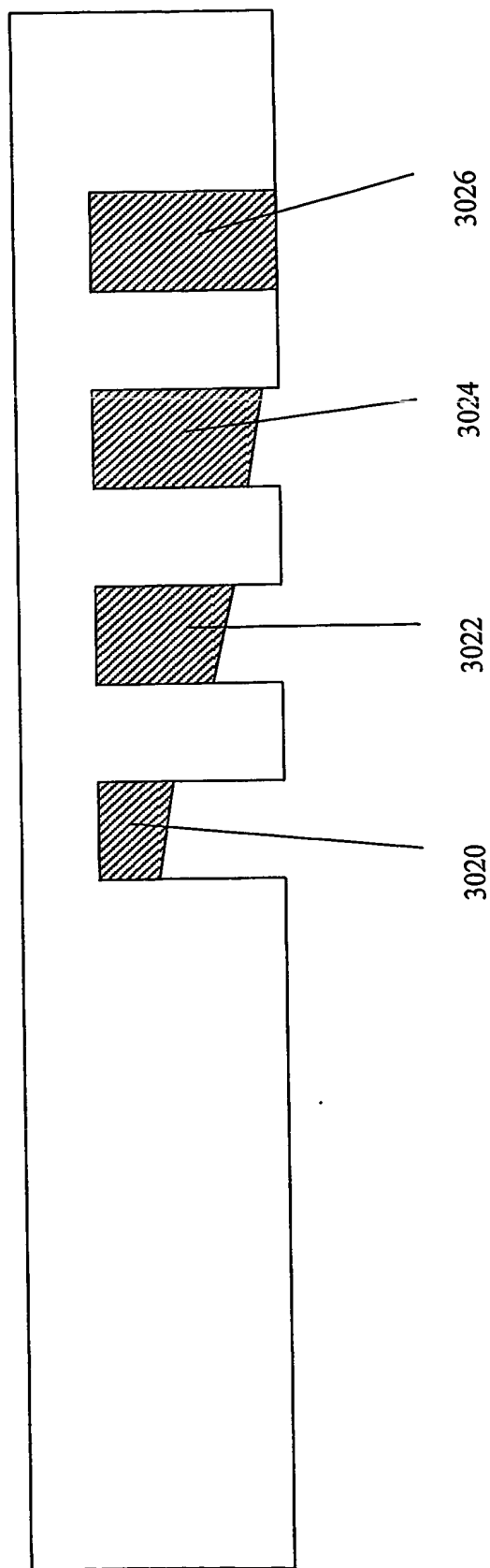


Fig. 30E

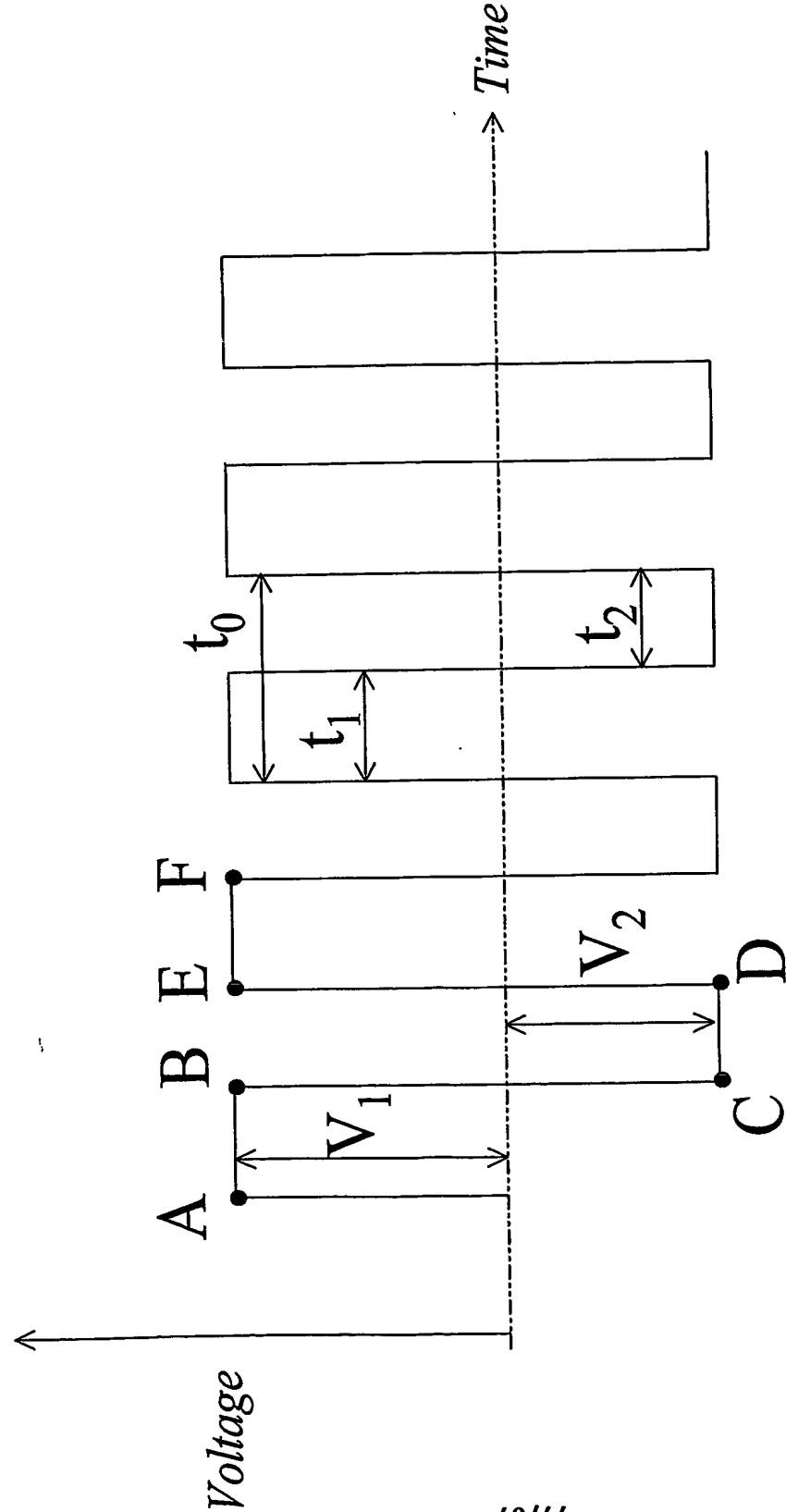
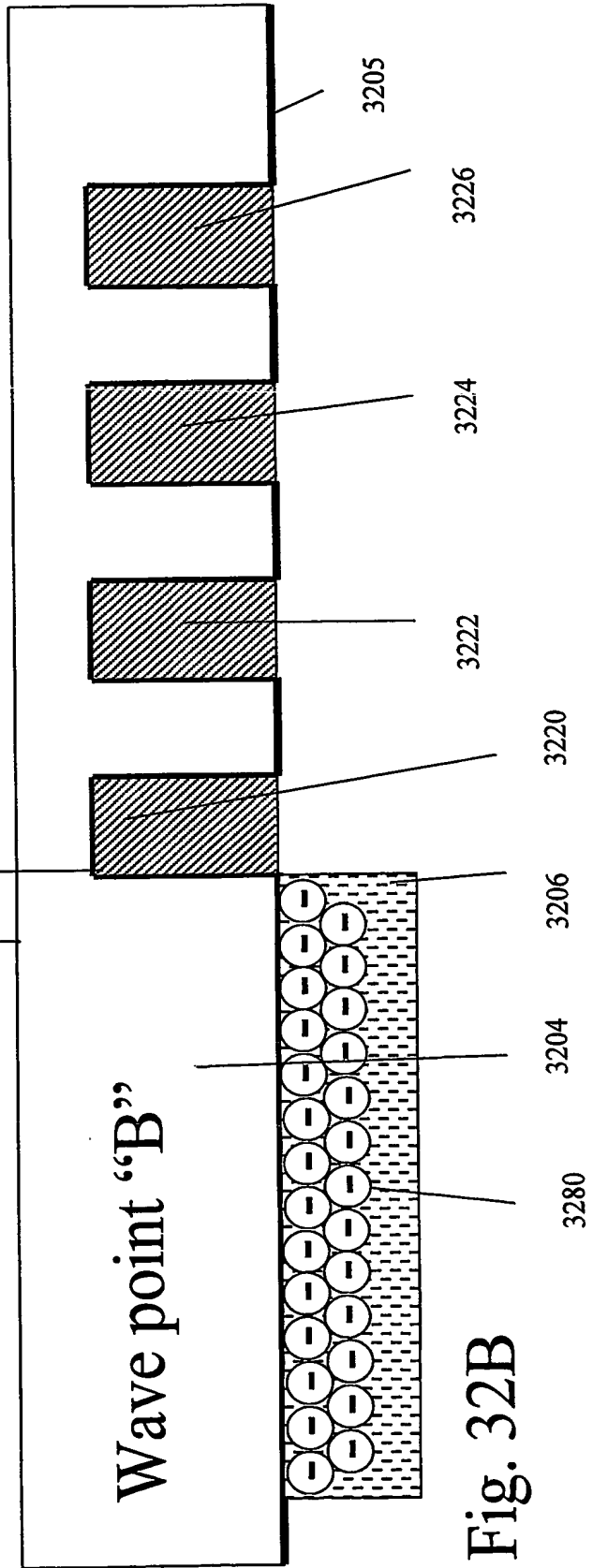
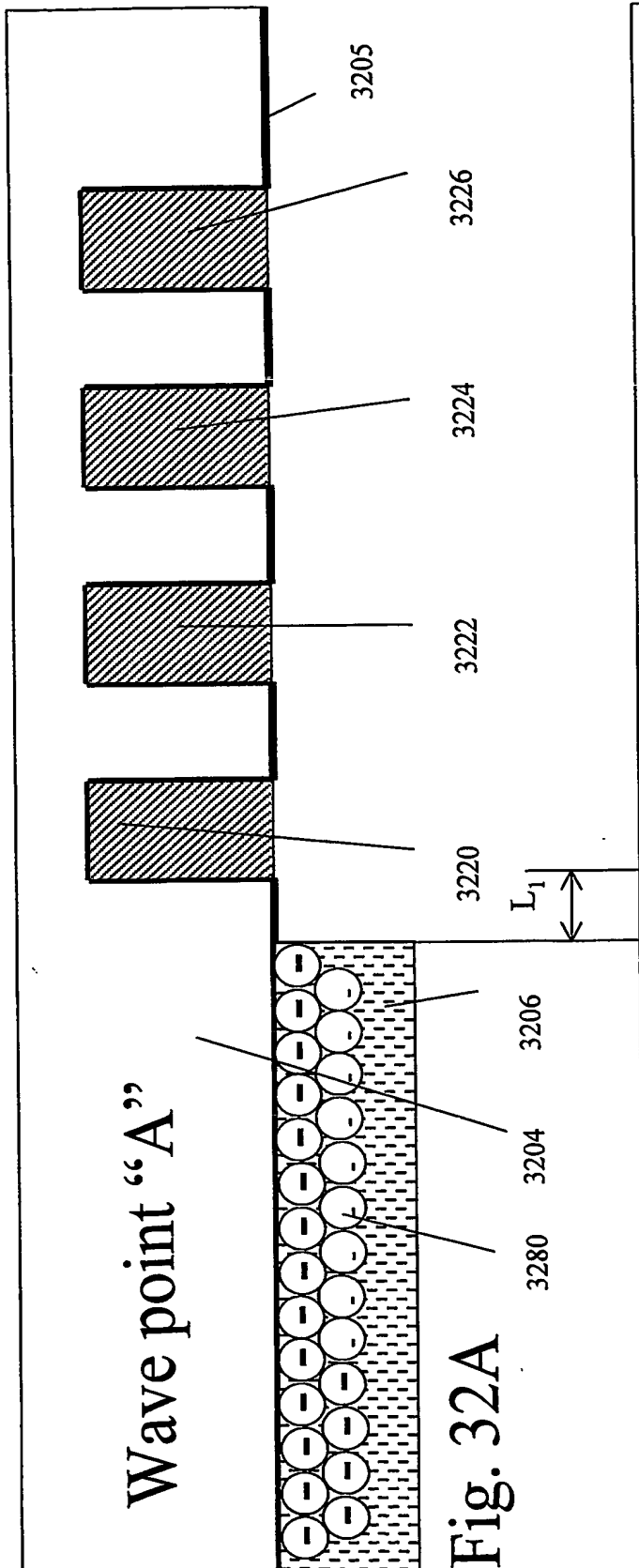
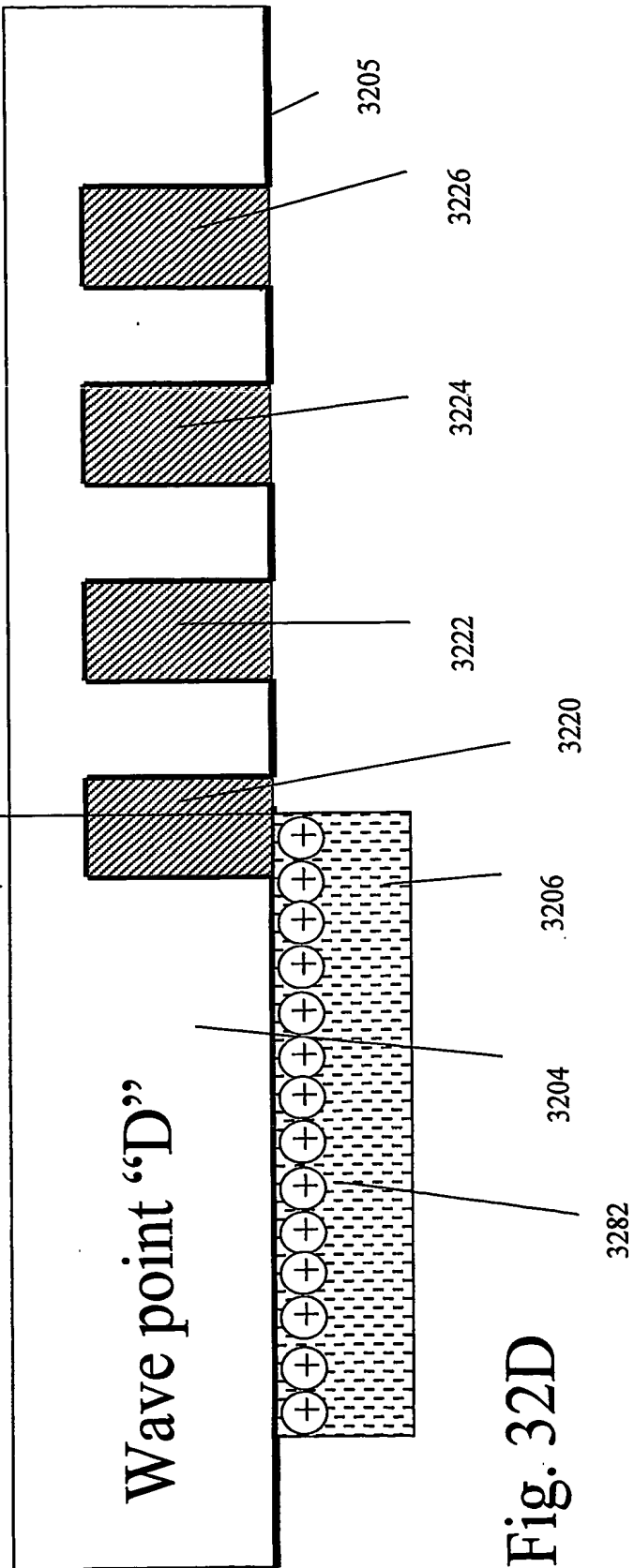
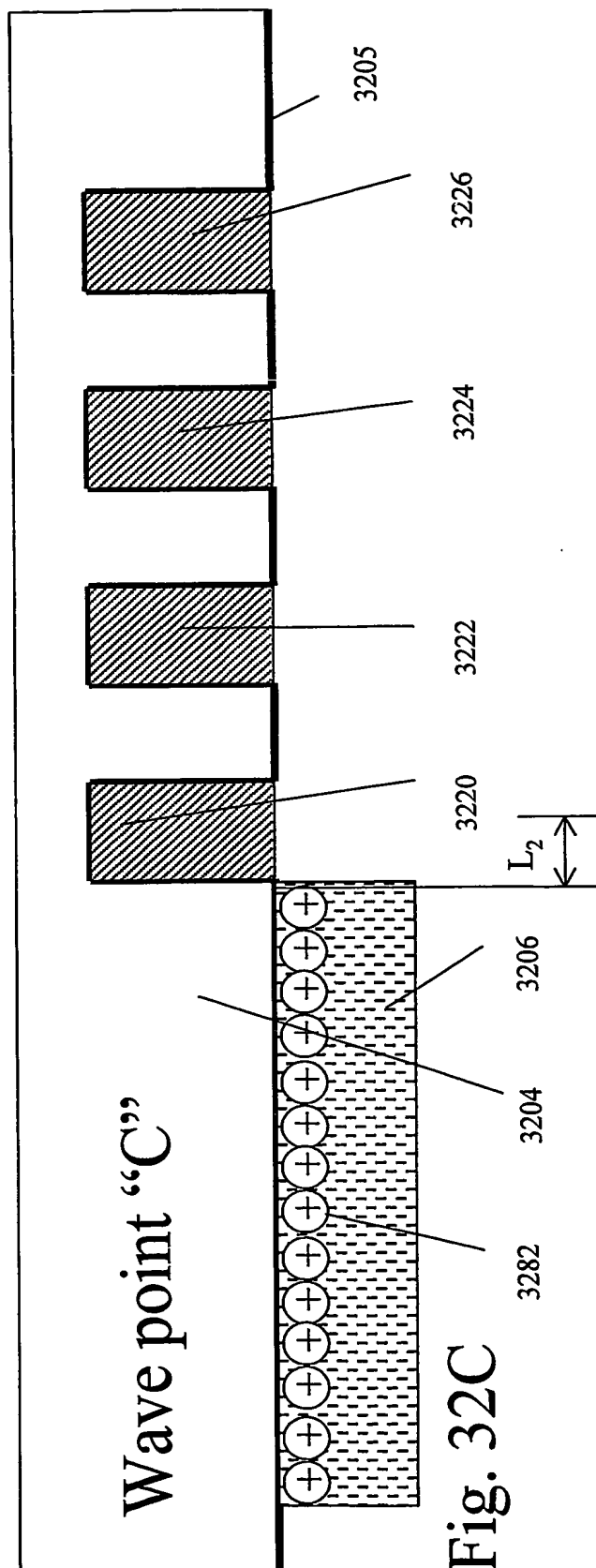


Fig. 31





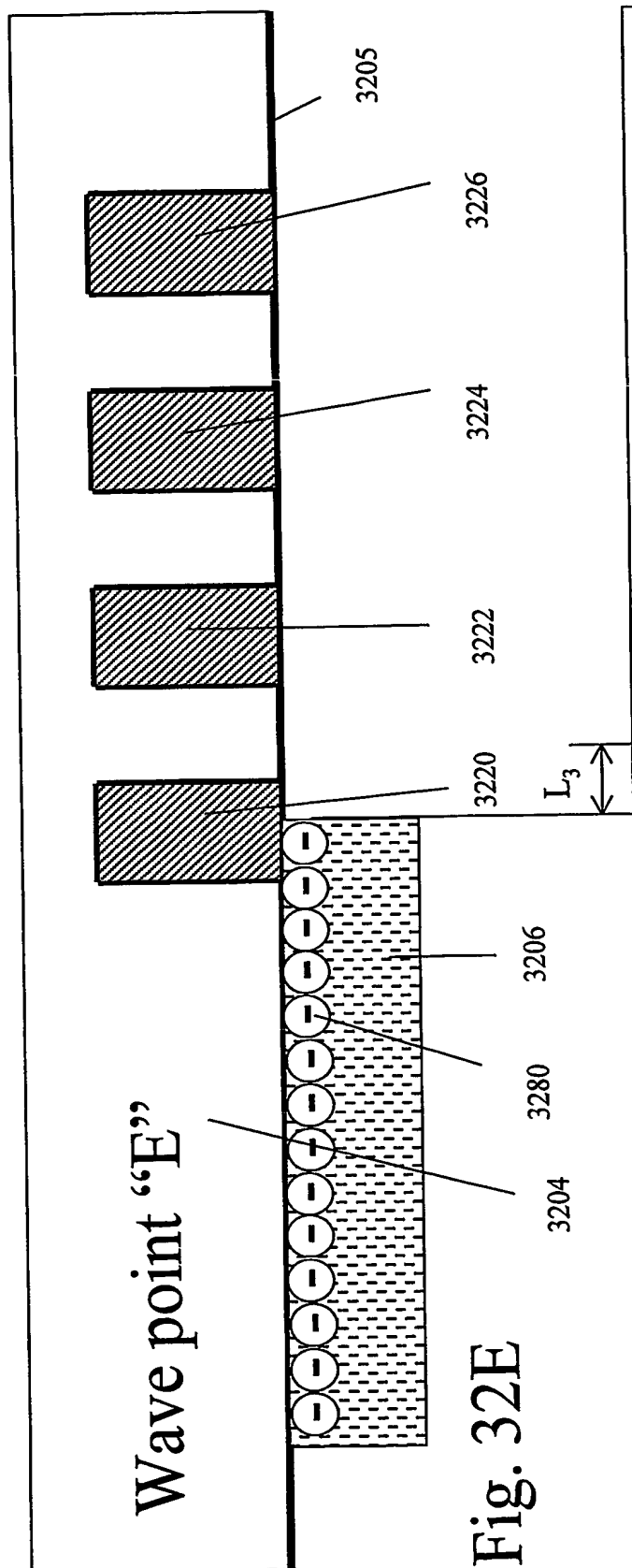


Fig. 32E

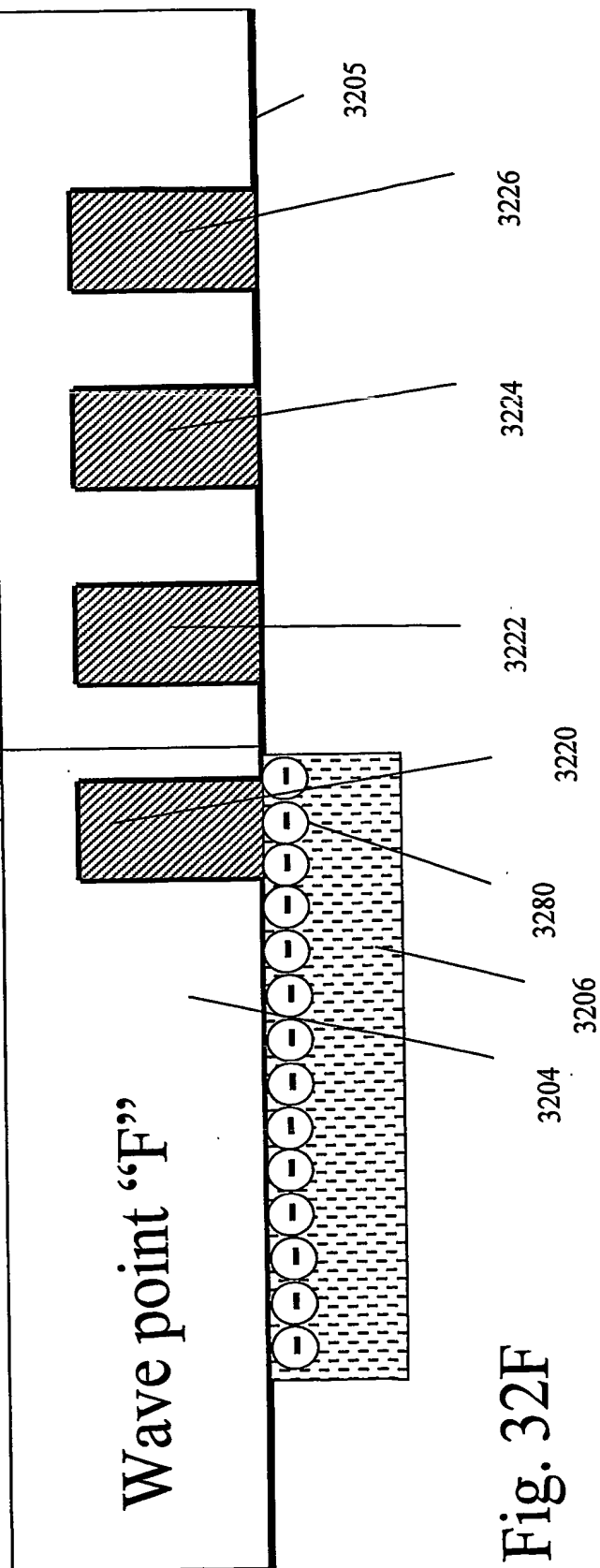


Fig. 32F

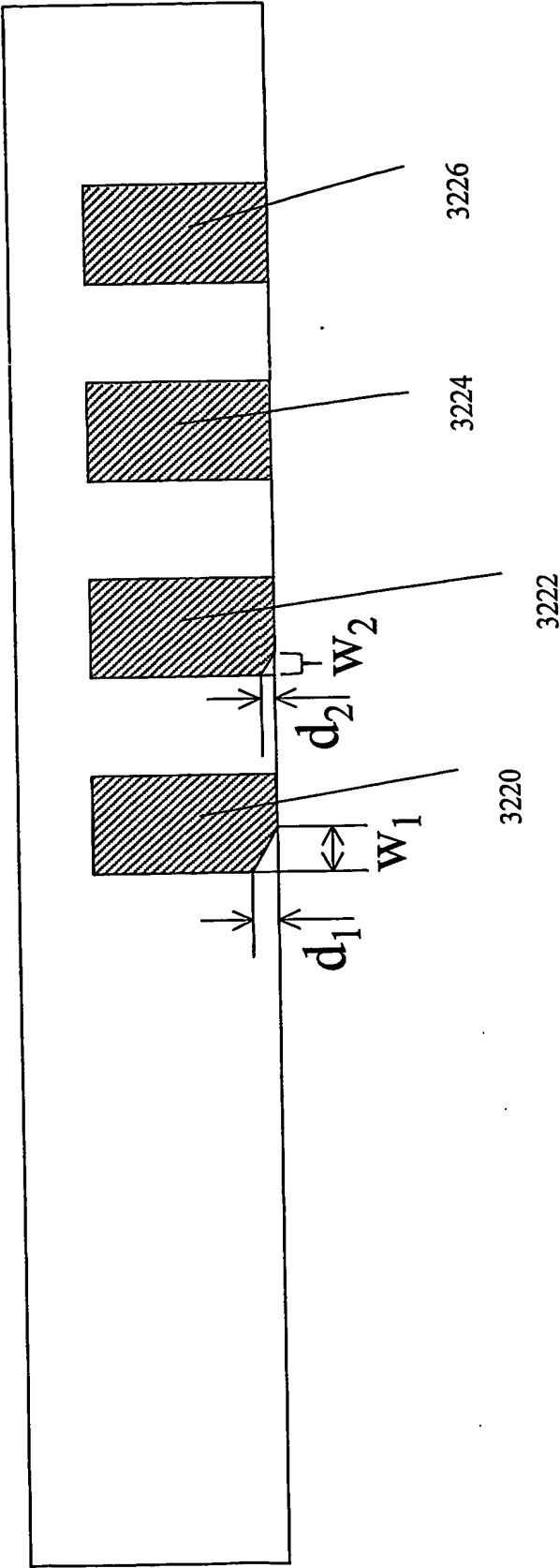


Fig. 32G